SOIL SURVEY OF

Hopkins County, Kentucky

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Kentucky Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1966-73. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Kentucky Agricultural Experiment Station. It is part of the technical assistance furnished to the Hopkins County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Hopkins County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification and woodland group of each.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the discussions of the mapping units, uses for crops and pasture, and the woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and for recreation areas in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering" tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Morphology, and Classification of the Soils."

Newcomers in Hopkins County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: Corn and soybeans on Collins silt loam. Soil in background is a Frondorf silt loam.

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SOIL SURVEY OF HOPKINS COUNTY, KENTUCKY

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE KENTUCKY AGRICULTURAL EXPERIMENT STATION

HOPKINS COUNTY is in the west-central part of Kentucky (fig. 1). It has an area of 353,790 acres or 553 square miles. The population in 1970 was 37,090. Madisonville is the largest town and is the county seat. The county is bordered on the north by Webster County and on the south by Christian County. Pond River is the boundary to the east, and Tradewater River to the west.

The county is in the Western Coal Field Physiographic Region of Kentucky. The central and southeastern parts of the county are mainly gently rolling uplands and broad silty bottoms. The soils on uplands have fragipans. A nearly level area of mostly clayey soils lies along the eastern edge of the county in the Green River and Pond River Valleys. Most of the rest of the county is rolling to steep wooded hills. The soils are moderately deep or deep over sandstone and acid shale. This hilly part of the county contains large areas of strip mine spoil and broad, mostly wet, marshy bottoms.

Farming has been important in Hopkins County since it was first settled. The most important crops are corn, soybeans, hay, and pasture. Hogs and beef cattle are the major types of livestock produced in the county. Coal mining and its supporting industries are the major sources of nonfarm income. Since about 1965, numerous manufacturing plants have located around Madisonville and Dawson Springs and have become very important to the growth and economy of the county.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Hopkins County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

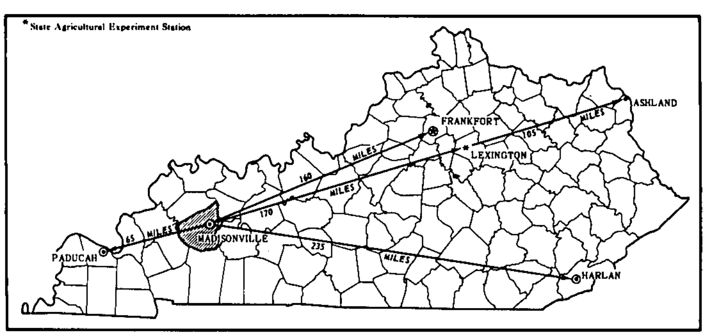

Figure 1.—Location of Hopkins County in Kentucky.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Frondorf and Loring, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Loring silt loam, 2 to 6 percent slopes, is one of several phases within the Loring series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Hop-

kins County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Markland-Collins complex is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Bonnie and Karnak soils, ponded, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gullied land is a land type in Hopkins County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Hopkins County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey have been grouped into three general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included soil associations are described on the following pages. The terms for texture used in the descriptive headings of the associations apply to the texture of the surface layer. For example, in the title of the first association, the words "medium textured" refer to the texture of the surface layer.

The General Soil Map of Hopkins County joins the General Soil Map of Caldwell County, Kentucky. The Zanesville-Dekalb-Muskingum-Falaya association in Caldwell County is separated by the Tradewater River from the Bonnie-Karnak association, the Zanesville-Frondorf-Belknap association, and the Bonnie-Steff-Stendal association in Hopkins County. The alluvial soils along the Tradewater River are included in the same soil association with the upland soils in Caldwell County; however, in Hopkins County the river valley is wide enough in places for the alluvial soils to be in a separate soil association. The upland soils in adjacent associations in the two counties are similar, but some of the soil names are different because recent knowledge has changed the concept of some soil series.

Soils Formed in Alluvium on Flood Plains and Stream Terraces

The nearly level soils that make up these associations are in the broad valleys of the Pond and Tradewater Rivers and their major tributaries. These soils formed mainly in water-deposited material that ranges from silt loam to silty clay. Some areas are ponded. Corn and soybeans are the main crops.

1. Belknap-Waverly association

Deep, somewhat poorly drained and poorly drained, nearly level, medium-textured soils on flood plains

This association is on nearly level flood plains along the upper reaches of Weirs, Deer, Otter, Elk, Pond, Flat, and Drakes Creeks. The dominant soils formed in alluvium (fig. 2).

This association makes up about 4 percent of the county. It is about 50 percent Belknap soils, 15 percent Waverly soils, and 35 percent soils of minor extent.

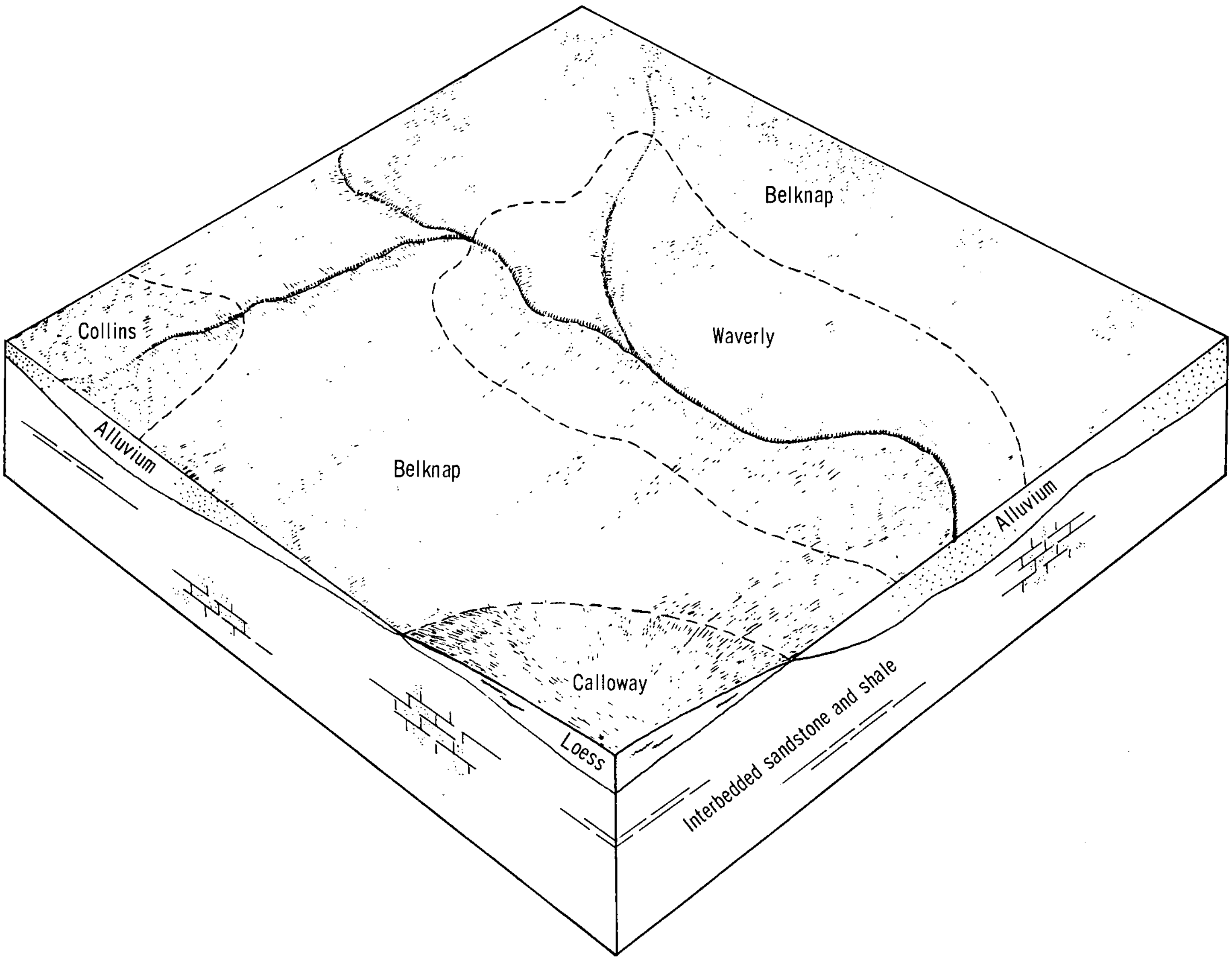

Figure 2.—**Typical pattern of soils and parent material in the Belknap-Waverly association.**

Belknap soils are nearly level, deep, and somewhat poorly drained. Waverly soils are nearly level, deep, and poorly drained. They are excessively wet during wet periods. Of minor extent are the moderately well drained Collins soils on flood plains and the moderately well drained Grenada and Sadler soils and somewhat poorly drained Calloway soils on stream terraces and uplands.

Most of this association has been cleared and is used for farming. The poorly drained areas are chiefly wooded. Cash-grain farming is the main enterprise, and corn and soybeans are the major crops. Wetness is the main limitation. Artificial drainage has been installed in many areas.

This association is suited to woods and pasture. It is also suited to the development of habitat for both woodland and wetland wildlife. Flooding and wetness severely limit most other nonfarm uses.

2. *Karnak-McGary-Belknap association*

Deep, poorly drained and somewhat poorly drained, nearly level, fine-textured and medium-textured soils on flood plains and stream terraces

This association is on a strip of nearly level flood plains and stream terraces along Pond River. It is about 4 miles wide in the northern part of the county and is one-quarter mile wide in the southern part. The dominant soils formed in clayey, slack-water deposits and in loamy alluvium that is high in content of silt (fig. 3).

This, association makes up about 10 percent of the county. It is about 60 percent Karnak soils, 10 percent McGary soils, 6 percent Belknap soils, and 24 percent soils of minor extent.

Karnak soils formed in slack-water deposits on flood plains. They are nearly level, deep, and poorly drained. McGary soils are nearly level, deep, and somewhat poorly drained. They formed in clayey, slack-water deposits on stream terraces. Belknap soils are nearly level, deep, and somewhat poorly drained. They formed on flood plains in loamy alluvium that is high in content of silt.

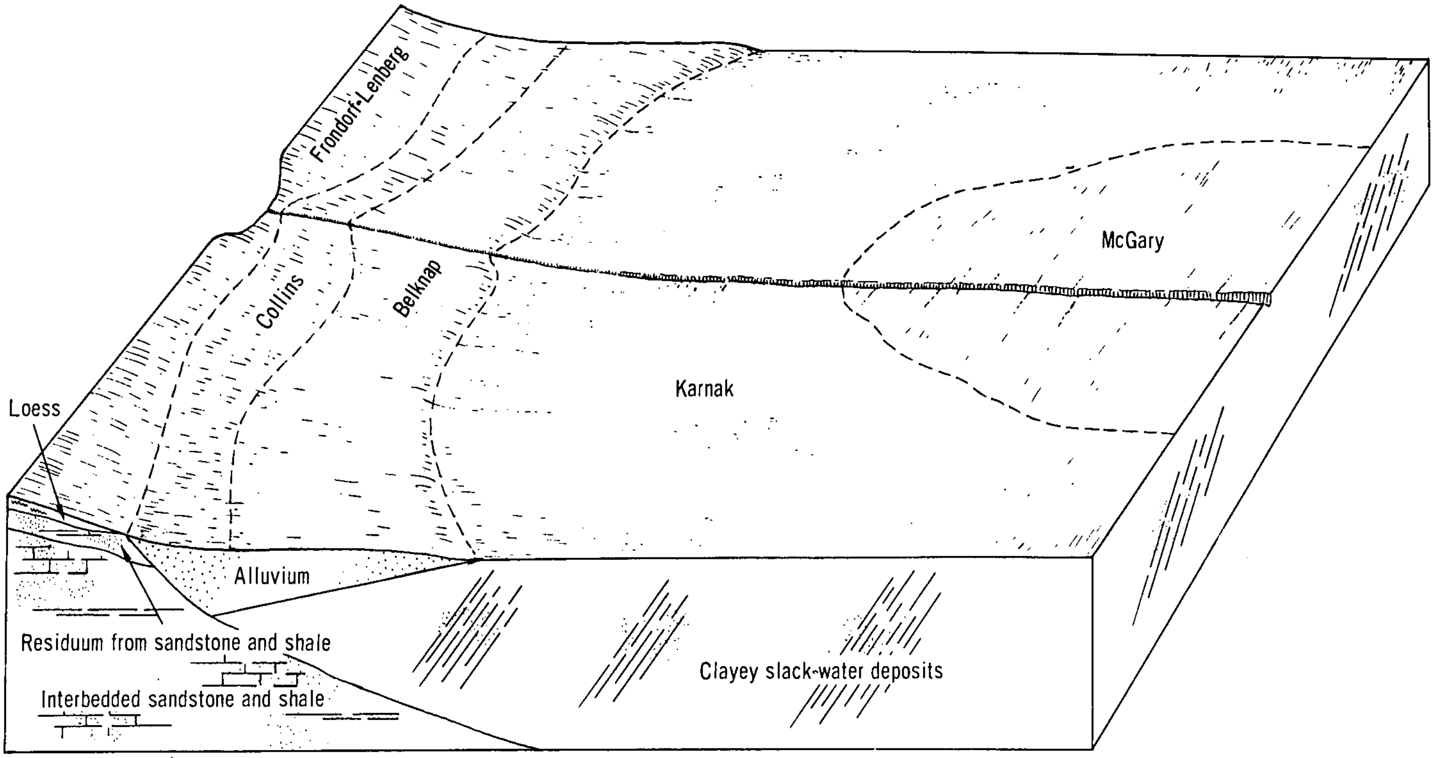

***Figure 3.*—Typical pattern of soils and parent material in the Karnak-McGary-Belknap association.**

Of minor extent are the poorly drained Waverly and moderately well drained Collins soils on flood plains and the somewhat poorly drained Weinbach soils, moderately well drained to well drained Otwell soils, and well drained to moderately well drained Markland soils on stream terraces.

More than half of this association has been cleared and is used for farming. Cash-grain farming is the main enterprise, and corn and soybeans are the major crops. The other areas are chiefly wooded. Large areas are being cleared and put into cultivation every year. Wetness is the main limitation. Artificial drainage has been installed in many areas of Karnak and Belknap soils.

This association is suited to woods and pasture. Flooding and wetness severely limit most nonfarm uses of Karnak and Belknap soils, and wetness is a limitation on McGary soils. A tile and brick plant operates in the association and uses clay from the subsoil of McGary and Markland soils.

3. *Bonnie-Steff-Stendal association*

Deep, poorly drained to moderately well drained, nearly level, medium-textured soils on flood plains

This association is on narrow flood plains along the Tradewater River and along the upper reaches of Clear, Lick, and Cany Creeks. The dominant soils formed in alluvium (fig. 4).

This association makes up about 3 percent of the county. It is about 50 percent Bonnie soils, 10 percent Steff soils, 10 percent Stendal soils, and 30 percent soils of minor extent.

Bonnie soils are nearly level, deep, and poorly drained. Steff soils are nearly level, deep, and moderately well drained. Stendal soils are nearly level, deep, and somewhat poorly drained. Of minor extent are the well drained Cuba soils and somewhat poorly drained Belknap soils on flood plains, the moderately well drained Sadler soils and somewhat poorly drained McGary and Calloway soils on stream terraces, and areas of ponded soils.

More than half of this association is wooded. A large part of it is flooded in winter and in spring, and some areas are ponded all or most of the year. Areas that are cleared are used for corn, soybeans, and hay. Wetness and flooding are the main limitations in the Bonnie and Stendal soils, and flooding is a limitation on Steff soils. Very little artificial drainage has been installed because suitable outlets are scarce.

All but the ponded areas of this association are suited to woods and pasture. Wetness and flooding severely limit many nonfarm uses of the Bonnie and Stendal soils, and the hazard of flooding limits most nonfarm uses of the Steff soils. Most of the association is suited to habitat for woodland and wetland wildlife.

4. *Bonnie-Karnak association*

Deep, poorly drained, nearly level, medium-textured and fine-textured soils on flood plains

This association is on narrow flood plains along the lower reaches of Clear Creek and along the Tradewater River near the mouth of Clear Creek. The dominant soils formed in alluvium and in clayey, slack-water deposits.

This association makes up about 1 percent of the county. It is about 33 percent Bonnie soils, 27 percent Karnak soils,

and 40 percent soils of minor extent.

Bonnie soils formed in alluvium. They are nearly level, deep, and poorly drained. Karnak soils also are nearly level, deep, and poorly drained. They formed in slack-water deposits. Of minor extent are the moderately well drained Steff and Collins soils and somewhat poorly drained Belknap and Stendal soils on flood plains and the moderately well drained Grenada soils and somewhat poorly drained McGary and Calloway soils on stream terraces.

Most of this association is wooded, marshy, or ponded. Almost all of it is flooded late in winter and in spring. A few areas are cleared and used for corn, soybeans, and pasture. Wetness and flooding are the main limitations. Artificial drainage is not feasible in most areas because suitable outlets are lacking.

All but the ponded areas of this association are suited to woods and pasture. Flooding severely limits most nonfarm uses.

Soils Formed in Loess on Uplands

The nearly level to sloping soils that make up this association are on uplands. These soils formed mainly in wind-deposited material that is high in content of silt. Corn, soybeans, and tobacco are the main cash crops. Pasture and hay are grown extensively and are fed to livestock on the farms on which they are grown.

5. *Loring-Grenada-Calloway association*

Deep, moderately well drained and somewhat poorly drained, nearly level to sloping, medium-textured soils on uplands

This association is in gently rolling areas of broad ridgetops, short side slopes, and nearly level valleys. The dominant soils formed in loess more than 4 feet thick (fig. 5).

This association makes up about 19 percent of the county. It is about 24 percent Loring soils, 21 percent Grenada

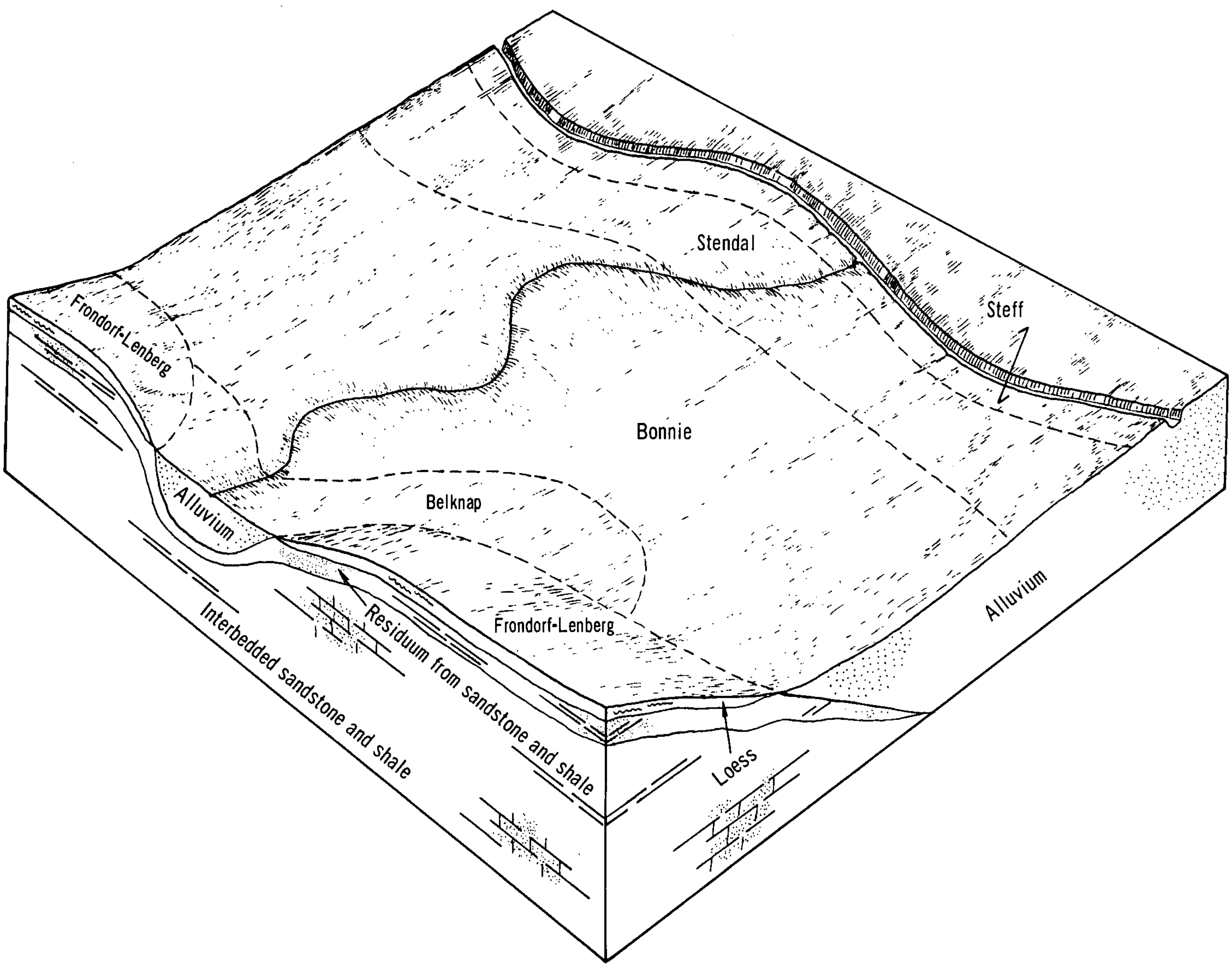

Figure 4.—Typical pattern of soils and parent material in the Bonnie-Steff-Stendal association.

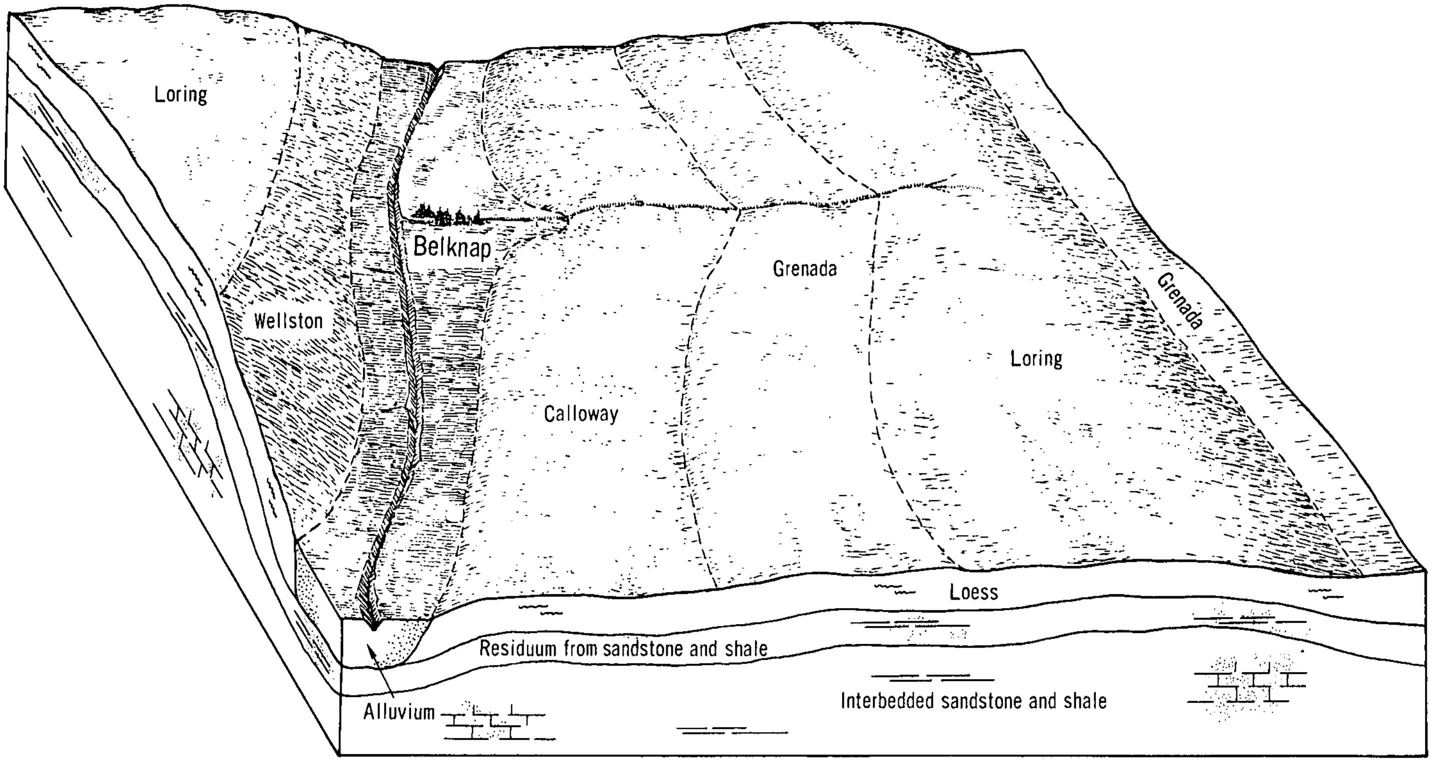

Figure 5.—**Typical pattern of soils and parent material in the Loring-Grenada-Calloway association.**

soils, 13 percent Calloway soils, and 42 percent soils of minor extent.

Loring soils are gently sloping to sloping, moderately well drained, and 24 to 35 inches deep over a fragipan. Grenada soils are gently sloping, moderately well drained, and 20 to 32 inches deep over a fragipan. Calloway soils are nearly level, somewhat poorly drained, and 20 to 30 inches deep over a fragipan. Of minor extent are the poorly drained Waverly soils, somewhat poorly drained Belknap soils, moderately well drained to well drained Zanesville soils, well-drained Wellston and Lenberg soils, and some areas of Strip mine.

Most of this association is cleared and is well suited to most locally grown crops. Grain, livestock, and tobacco farming are the main enterprises, and corn, soybeans, pasture, hay, and tobacco are the major crops. The steeper soils are not suited to row crops because the hazard of erosion is very severe, but these soils are of minor importance. Wetness is the main limitation for the nearly level soils.

This association has potential for community and industrial development. It is the most densely populated part of the county and contains most of the manufacturing industries. Most of the soils of this association have a fragipan that limits the movement of air and water.

Soils Formed Mainly in a Loess Mantle and in the Underlying Material Weathered From Sandstone and Shale

The nearly level to steep soils that make up these associations are on uplands. Most of these soils formed in a thin loess mantle and in the underlying material weathered from sandstone and shale. Some formed in loess more than 4 feet thick. Also, there are areas of Strip mine and areas of soils that formed in medium-textured, water-deposited material. Corn, soybeans, and tobacco are the main cash crops. Pasture and hay plants are grown and fed to livestock on the farms on which they are grown. Most of the steep hillsides are wooded.

6. *Loring-Frondorf-Zanesville association*

Deep and moderately deep, moderately well drained and well drained, gently sloping to steep, medium-textured and moderately fine textured soils on uplands

This association is on gently sloping to steep, mainly wooded hills that have narrow ridges and in narrow valleys. In the association are the range of hills locally known as the Shake Rag Hills. The dominant soils formed in loess and in material weathered from acid sandstone and shale and a thin mantle of loess (fig. 6).

This association makes up about 20 percent of the county. It is about 17 percent Loring soils, 15 percent Frondorf soils, 15 percent Zanesville soils, and 53 percent soils of minor extent.

Loring soils are gently sloping to sloping, moderately well drained, and 24 to 35 inches deep over a fragipan. Frondorf soils are moderately steep to steep, well-drained, and moderately deep over bedrock. Zanesville soils are gently sloping to moderately steep, well drained to moderately well drained, and 24 to 32 inches deep over a fragipan. Of minor extent are the somewhat poorly drained

Belknap and moderately well drained Collins soils on flood plains, the well drained Wellston and moderately well drained Grenada soils on ridgetops and foot slopes, and the somewhat excessively drained Ramsey and well-drained Lenberg, Wellston, and Steinsburg soils on side slopes.

Most of this association is wooded. Some ridges and most valleys are cleared and cultivated. The main crops are corn, soybeans, hay, and pasture. The hazard of erosion is the main limitation.

The steeper soils are not suited to cultivation because the hazard of erosion is very severe. The potential of the soils for timber is fair to good. The gently sloping and sloping soils are suitable for homesites. Other areas could be developed as wooded parks, picnic areas, or other recreational areas.

7. *Strip mine-Frondorf association*

Deep and moderately deep, well-drained, moderately steep to very steep, medium-textured and moderately fine textured soils on uplands

This association consists of sprawling mounds of spoil material from strip mining interspersed with narrow bands of moderately steep and steep soils in wooded areas. Most of the soils formed in material weathered from acid sandstone and shale (fig. 7).

This association makes up about 9 percent of the county. It is about 65 percent Strip mine, 8 percent Frondorf soils, and 27 percent soils of minor extent.

Strip mine is a mixture of stones and unconsolidated material deposited by mining machines. Slopes are mostly short and steep. Frondorf soils are moderately steep to steep, well drained, and moderately deep to bedrock. Of minor extent are the poorly drained Waverly and Bonnie soils and somewhat poorly drained Belknap soils on flood plains and the well-drained Wellston and Lenberg soils,

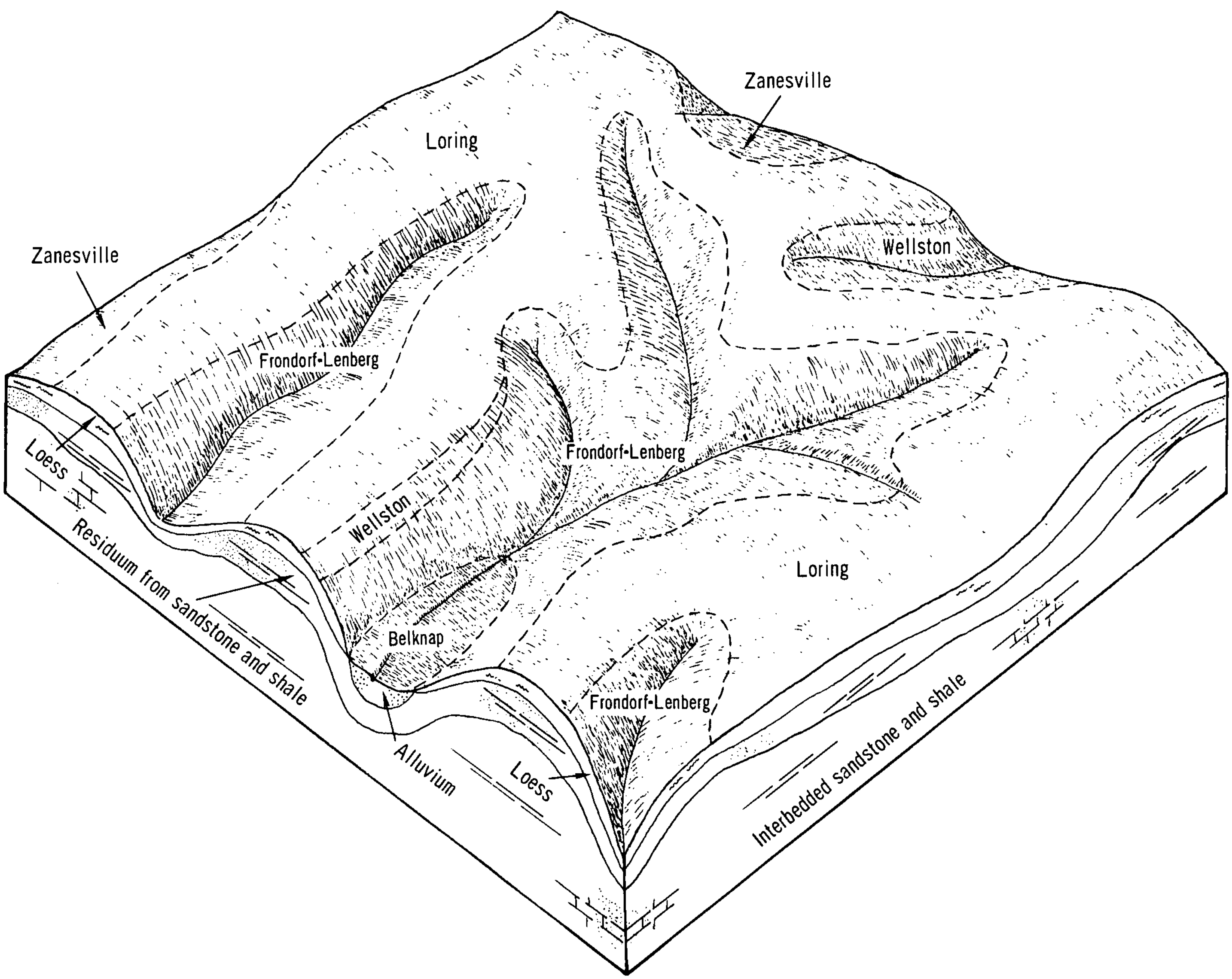

Figure 6.—Typical pattern of soils and parent material in the Loring-Frondorf-Zanesville association.

Figure 7.—**Typical landscape in the Strip mine-Frondorf association. Mine spoil interspersed with Frondorf and Lenberg soils in background.**

well drained to moderately well drained Zanesville soils, and moderately well drained Sadler soils on uplands.

Most of this association is either wooded or is spoil bank in various stages of vegetation. Coal mining is the main enterprise, and most of the association is owned by coal companies. The few farms that remain are mainly used for part-time general farming.

Many areas of Strip mine in this association are suitable for use as landfill for solid waste, and two such operations are in the association. Areas in this association also have some potential for timber production and for development as woodland wildlife habitat.

8. Zanesville-Sadler association

Deep, well drained to moderately well drained, gently sloping to moderately steep, medium-textured soils on uplands

This association is in gently rolling areas that consist of broad ridgetops, short side slopes, and nearly level valleys. The dominant soils formed in material weathered from acid sandstone and shale and the overlying thin loess mantle (fig. 8).

This association makes up about 8 percent of the county. It is about 40 percent Zanesville soils, 25 percent Sadler soils, and 35 percent soils of minor extent.

Zanesville soils are gently sloping to moderately steep, well drained to moderately well drained, and 24 to 32 inches deep over a fragipan. Sadler soils are gently sloping, moderately well drained, and 18 to 28 inches deep over a fragipan. Of minor extent are the poorly drained Waverly soils and somewhat poorly drained Belknap soils on flood plains, the well-drained Wellston, Frondorf, and Lenberg soils in the steeper areas, the somewhat poorly drained Calloway soils on ridgetops and stream terraces, and some areas of Strip mine.

Most of this association has been cleared and is used for farming. A few large areas are wooded. Grain, livestock, and tobacco farming are the main enterprises. The major crops are corn, soybeans, tobacco, hay, and pasture. The

hazard of erosion is the main limitation, and some soils are not suited to cultivation because the hazard of erosion is very severe. Wetness is a limitation in the nearly level valleys, but artificial drainage is feasible in most of these areas.

Most areas of this association are suitable for homesites. Most of these soils have a fragipan, and centralized sewage treatment facilities are necessary in intensively developed areas. The association is also used extensively for deep mining and strip mining.

9. *Zanesville-Frondorf-Belknap association*

Deep and moderately deep, well-drained to somewhat poorly drained, nearly level to steep, medium-textured soils on uplands and flood plains.

This association is on long narrow ridges, moderately steep to steep wooded hills, and narrow valleys. The dominant soils formed in material weathered from acid sandstone and shale and the overlying thin loess mantle on uplands and in alluvium on flood plains of narrow valleys (fig. 9).

This association makes up about 26 percent of the county. It is the largest in the county and is about 40 percent Zanesville soils, 10 percent Frondorf soils, 10 percent Belknap soils, and 40 percent soils of minor extent.

Zanesville soils are gently sloping to moderately steep, well drained to moderately well drained, and 24 to 32 inches deep over a fragipan. Frondorf soils are moderately steep to steep, well drained, and moderately deep over bedrock. Belknap soils are on flood plains. They are nearly level, somewhat poorly drained, and deep. Of minor extent are the poorly drained Waverly and Bonnie soils and moderately well drained Collins soils on flood plains, the well drained Wellston soils and moderately well drained Sadler soils on ridgetops, the well-drained Steinburg and Lenberg soils and somewhat excessively drained, shallow Ramsey soils on the steeper side slopes, and areas of Strip mine.

Most of this association is wooded. Some ridges and most valleys have been cleared and are cultivated. The major crops are corn, soybeans, hay, and pasture.

Coal is mined in this association, and a large part of the association is owned by coal companies. The gently sloping and sloping soils are suitable for home and industrial sites. Some manufacturing industries are located in the southern part of the association. The potential for timber is fair to good. This association also has potential for development of wildlife habitat and recreational areas. The Western Kentucky 4-H Camp is located on the association.

Descriptions of the Soils

In this section the soils of Hopkins County are described in detail and their use and management are explained. Each soil series is described in detail, and then, briefly, the mapping units in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description

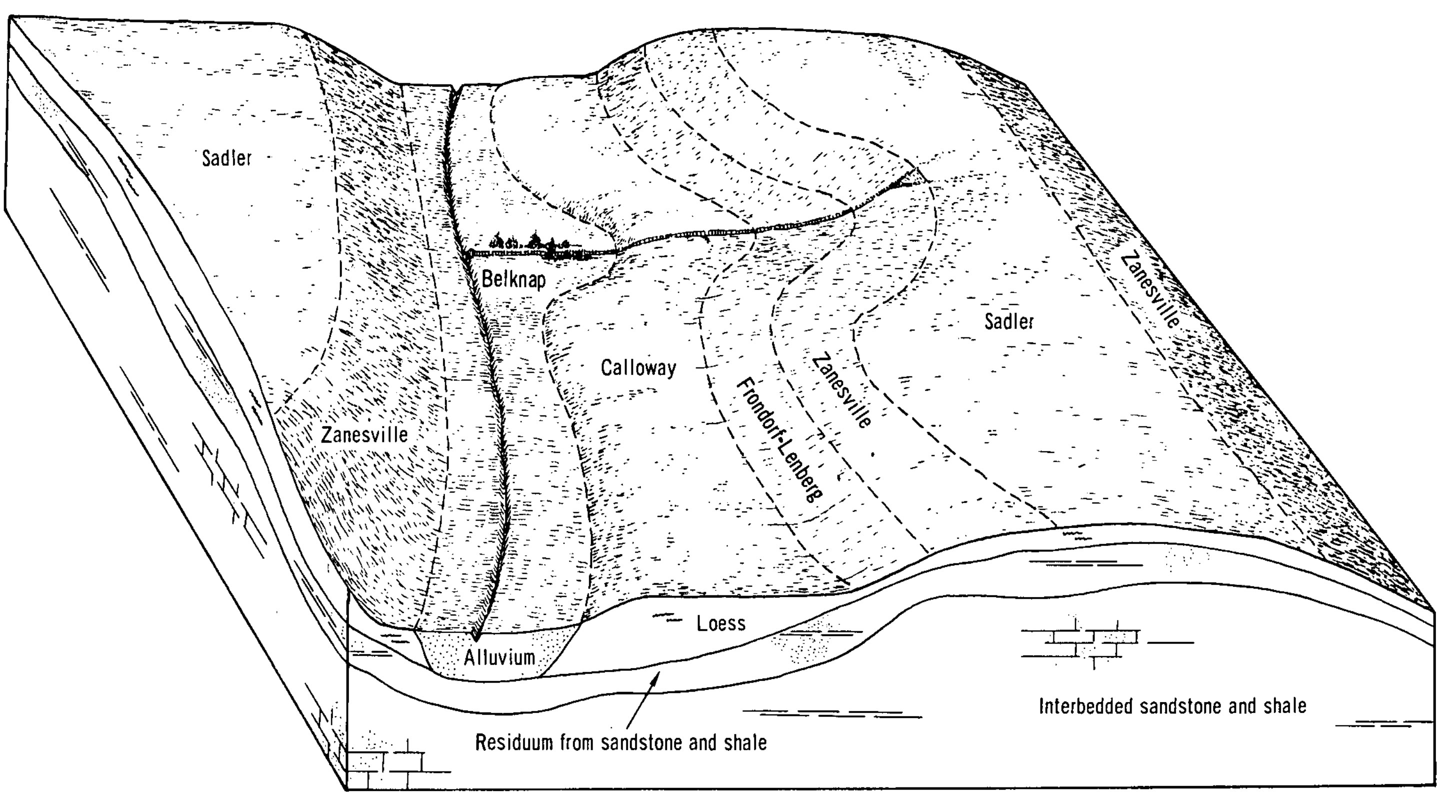

Figure 8.—Typical pattern of soils and parent material in the Zanesville-Sadler association.

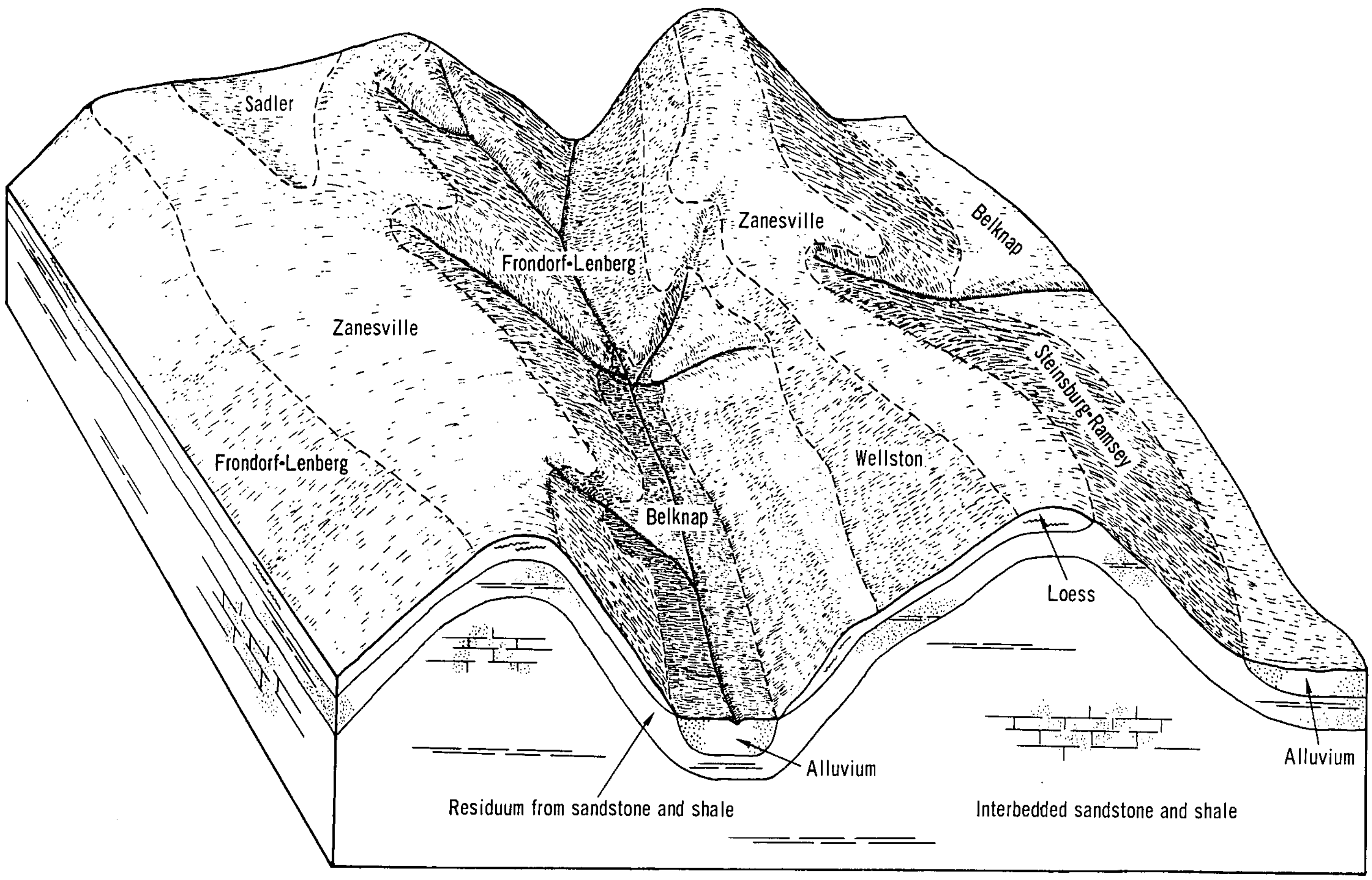

Figure 9.—**Typical pattern of soils and parent material in the Zanesville-Frondorf-Belknap association.**

of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The profile described in the soil series is representative of mapping units in that series. If a given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit. The description of each mapping unit contains suggestions on how the soil can be managed.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Mine dump, for example, does not belong to a soil series, but nevertheless, is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol which identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland group in which the mapping unit has been placed. (N) following the woodland group indicates northern and eastern aspects; (S) indicates southern and western aspects. The page where each mapping unit is described can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*9*).[1]

Belknap Series

The Belknap series consists of deep, nearly level, somewhat poorly drained soils on flood plains in valleys. These soils formed in acid alluvium that washed mostly from soils formed in loess.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsoil is 16 inches thick. The upper 7 inches is friable, brown silt loam mottled with light brownish gray, and the lower 9 inches is friable, light brownish-gray silt loam mottled with pale brown and brown. The underlying material to a depth of 60 inches is gray silt loam that is mottled in shades of brown.

[1] Italic numbers in parentheses refer to Literature Cited, p. 60.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Belknap silt loam	42,785	12.1
Bonnie silt loam	9,000	2.5
Bonnie and Karnak soils, ponded	5,810	1.6
Calloway silt loam	9,325	2.6
Collins silt loam	9,195	2.6
Cuba silt loam	785	.2
Frondorf-Lenberg silt loams, 12 to 30 percent slopes	54,705	15.5
Grenada silt loam, 2 to 6 percent slopes	14,515	4.1
Grenada silt loam, 2 to 6 percent slopes, severely eroded	730	.2
Gullied land	550	.2
Karnak silt loam, overwash	2,980	.8
Karnak silty clay	30,920	8.7
Loring silt loam, 2 to 6 percent slopes	17,615	5.0
Loring silt loam, 6 to 12 percent slopes	8,830	2.5
Loring silty clay loam, 6 to 12 percent slopes, severely eroded	2,525	.7
Markland silty clay, 6 to 12 percent slopes, severely eroded	455	.1
Markland-Collins complex	805	.2
McGary silt loam	4,760	1.4
McGary loam, loamy subsoil variant	575	.2
Mine dump	1,270	.4
Mine wash	715	.2
Otwell silt loam, 2 to 6 percent slopes	850	.2
Ramsey-Steinsburg-Rock outcrop complex, 30 to 50 percent slopes	1,075	.3
Sadler silt loam, 2 to 6 percent slopes	9,940	2.8
Steff silt loam	1,430	.4
Steinsburg-Ramsey loams, 20 to 30 percent slopes	6,135	1.7
Stendal silt loam	2,010	.6
Strip mine	29,595	8.4
Waverly silt loam	7,930	2.2
Weinbach silt loam	1,280	.4
Wellston silt loam, 6 to 12 percent slopes	2,095	.6
Wellston silt loam, 12 to 20 percent slopes	1,285	.4
Wellston silty clay loam, 6 to 12 percent slopes, severely eroded	3,110	.9
Zanesville silt loam, 2 to 6 percent slopes	21,410	6.1
Zanesville silt loam, 6 to 12 percent slopes	24,055	6.8
Zanesville silt loam, 6 to 12 percent slopes, severely eroded	19,405	5.5
Zanesville silt loam, 12 to 20 percent slopes, severely eroded	1,100	.3
Borrow pits	335	.1
Water [1]	1,900	.5
Total	353,790	100.0

[1] Includes all bodies of water that range from about 5 to 400 acres in size.

These soils have a deep root zone and are easy to till. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is high, and the content of organic matter is low. The water table rises to within about 12 inches of the surface during periods of heavy rain unless the soils are artifically drained.

Most areas are cleared and used for row crops and pasture. Crops respond well to additions of lime and fertilizer. Some areas are wooded.

Representative profile of Belknap silt loam, 100 feet south of gas well, 200 yards east of Kentucky Highway 281, 0.8 mile northeast of junction with the Pennyrile Parkway:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; medium acid; abrupt, smooth boundary.

***Figure 10.*—Corn on somewhat poorly drained Belknap silt loam that has been tile drained.**

B21—8 to 15 inches, brown (10YR 5/3) silt loam; common, fine, distinct mottles of light brownish gray (10YR 6/2); very weak, medium, subangular blocky structure; friable; weak bedding planes visible; few roots; few fine pores; common yellowish-brown concretionary material; strongly acid; clear, smooth boundary.

B22g—15 to 24 inches, light brownish-gray (10YR 6/2) silt loam; many, fine, faint, pale-brown (10YR 6/3) and distinct, brown (10YR 5/3) mottles; weak, medium, subangular blocky structure; friable; few small pores; few roots; few, small, soft, brown concretions; strongly acid; gradual, smooth boundary.

C1g—24 to 30 inches, gray (10YR 6/1) silt loam; many, fine, faint, light brownish-gray (10YR 6/2) and grayish-brown (10YR 5/2) mottles; massive; friable; few roots; many soft brown and few black concretions; strongly acid; gradual, smooth boundary.

C2g—30 to 60 inches, gray (10YR 6/1) silt loam; common, fine, distinct, grayish-brown (10YR 5/2) and brown (10YR 4/3) mottles; massive; friable; many brown and black concretions; strongly acid.

Depth to bedrock is more than 12 feet. The solum is 20 to 40 inches thick. Reaction is strongly acid to very strongly acid. The Ap horizon is less acid where limed.

The A horizon is brown (10YR 4/3 or 5/3), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). The B21 horizon is brown (10YR 4/3 or 5/3), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4) and has few to many mottles in shades of gray. The B22g horizon is light gray (10YR 7/1 or 7/2), gray (10YR 5/1 or 6/1), or light brownish gray (10YR 6/2), and it has common or many mottles in shades of brown. The C horizon is similar in color to the B22g horizon.

Belknap soils are near the poorly drained Waverly soils and the moderately well drained Collins soils. They are similar to the Stendal soils in drainage, but contain less clay in the B horizon.

Bn—Belknap silt loam. This nearly level soil is near streams and in narrow valleys. It formed in recent alluvium. Areas in the valleys are near upland soils that formed in loess. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Waverly and Collins soils. Also included are a few areas of similar soils in which the subsoil is loam or fine sandy loam.

This Belknap soil is well suited only to row crops and pasture and hay plants that withstand wetness. If artificially drained, it is well suited to corn and soybeans (fig. 10) as well as to all the locally grown grasses, to lespedeza, and

to alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Floods occur in winter and early in spring, but seldom during the growing season. Wetness, the main limitation, can be reduced by artifical drainage.

Most urban uses of this soil are severely limited by flooding and wetness. Capability unit IIw-1; woodland group 1w1.

Bonnie Series

The Bonnie series consists of deep, nearly level, poorly drained soils on flood plains in valleys and depressions. These soils formed in acid alluvium that washed mostly from soils derived from loess, sandstone, and shale.

In a representative profile the surface layer is gray silt loam about 8 inches thick. The subsoil is 30 inches thick. The upper 6 inches is friable, light brownish-gray silt loam mottled with gray and pale brown, and the lower 24 inches is friable, light-gray silt loam mottled with light brownish gray and yellowish brown. The underlying material to a depth of 60 inches is light-gray silt loam that is mottled with yellowish brown.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is moderate, and the content of organic matter is low. During wet periods the water table is at or near the surface unless the soils are artificially drained.

Most of the acreage is wooded. A few areas are cleared and used for row crops, hay, or pasture. In drained areas, crop response is fair to additions of lime and fertilizer.

Representative profile of Bonnie silt loam, 150 feet west of Osburn road, 2 miles north of Richland:

A1—0 to 8 inches, gray (10YR 5/1) silt loam; weak, fine, granular structure; friable; upper 2 inches of horizon is predominantly roots; common roots in lower part; common, round, soft, brown concretions with black interiors; very strongly acid; abrupt, smooth boundary.

B1g—8 to 14 inches, light brownish-gray (10YR 6/2) silt loam; common, fine, faint mottles of gray (10YR 6/1) and pale brown (10YR 6/3); weak, very fine, subangular blocky structure; friable; few roots; few soft brown concretions; very strongly acid; diffuse, wavy boundary.

B2g—14 to 38 inches, light-gray (10YR 7/1) silt loam; common, fine, faint mottles of light brownish gray (10YR 6/2) and yellowish brown (10YR 5/4); weak, fine, subangular blocky structure; friable; few roots; few small pores; common, soft, small, brown and black concretions; very strongly acid; clear, smooth boundary.

Cg—38 to 60 inches, light-gray (10YR 7/1) silt loam; common, fine, distinct mottles of yellowish brown (10YR 5/4 and 5/6); massive; friable; common, small, soft, brown and black concretions; very strongly acid.

Depth to bedrock is more than 12 feet. The solum is 20 to 40 inches thick. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed.

The Ap or A1 horizon is gray (10YR 6/1) to dark grayish brown (10YR 4/2). In some places the thin A1 horizon has a chroma of 3. The B horizon ranges from light gray (10YR 7/1) to grayish brown (10YR 5/2) and has few to many mottles in shades of brown and gray. The C horizon is similar in color to the B horizon.

Bonnie soils are near the somewhat poorly drained Stendal soils. They are similar to the Waverly soils in drainage, but have more clay in the B horizon.

Bo—Bonnie silt loam. This soil is in broad, low-lying valleys along streams that carry acid mine waste. It is also at the edge of acid-water marshes. It has the profile described as representative of the series. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Stendal and Waverly soils. Also included are small areas where the subsoil is silty clay loam or the soil is extremely acid.

Flooding is a severe hazard to row crops. Erosion is not a hazard. Soybeans and corn can be grown year after year in the same area if it is adequately drained. Many areas lack suitable drainage outlets. Pasture and hay plants can be grown in areas that are not affected by acid water from mines. Suitable pasture and hay plants are tall fescue and alsike and white clovers.

Flooding and wetness severely limit most urban uses of this soil. Capability unit IIIw-1; woodland group 1w2.

BP—Bonnie and Karnak soils, ponded. These soils are in depressions on flood plains. Slope is 0 to 2 percent. Some areas are entirely Bonnie soil, others are Karnak soil, and still others are a mixture of both soils. The Bonnie soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are heavy silt loam or light silty clay loam. The Karnak soil has a profile similar to the one described as representative of the Karnak series, but it is slightly more acid throughout.

Included with these soils in mapping are a few small areas of similar soils at slightly higher elevations that are under water only during wet seasons. Also included are a few small areas of better drained soils derived from similar parent material.

Undrained areas of these soils are not suitable for cultivation, pasture, hay crops, or woodland. Runoff is received from areas of acid strip mine spoil and seepage from old underground mines. Water is on or near the surface throughout the year. The original vegetation is dead, and many dead snags remain standing. The vegetation is mostly cattails and small water-tolerant birch trees. Artificial drainage is not feasible because most areas lack suitable outlets.

Urban and recreational developments are severely limited by wetness and flooding. Developments for wetland wildlife are well suited. Capability unit VIIw-1; not assigned to a woodland group.

Calloway Series

The Calloway series consists of nearly level, somewhat poorly drained soils that have a fragipan. These soils are on broad ridgetops on uplands and on stream terraces in valleys. The soils on uplands formed in loess more than 4 feet thick, and those on terraces formed in alluvium that washed mostly from soils derived from loess.

In a representative profile the surface layer is dark grayish-brown silt loam about 9 inches thick. The upper 9 inches of the subsoil is friable, yellowish-brown silt loam mottled with light gray. The next 9 inches is friable, light-gray silt loam mottled with yellowish brown. The lower part of the subsoil to a depth of 60 inches is a fragipan of firm, light brownish-gray and yellowish-brown silty clay loam.

These soils have a moderately deep root zone and are easily tilled. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. Natural fertility is moderate.

Most areas are cleared and used for pasture, soybeans, and corn. Crops respond well to additions of lime and fertilizer.

Representative profile of Calloway silt loam, 200 feet west of Frank Cox road, 1,500 feet northeast of Kentucky Highway 892:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; many roots; many, small, black concretions and few, medium, brown concretions; slightly acid; abrupt, smooth boundary.

B&A—9 to 18 inches, yellowish-brown (10YR 5/4) silt loam; many, medium, distinct, light-gray (10YR 7/2) mottles in the A horizon part; weak, fine, subangular blocky and granular structure; friable; common roots; common, small, black and medium, brown concretions; medium acid; clear, smooth boundary.

A'2—18 to 27 inches, light-gray (10YR 6/1) silt loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; few roots; few, medium, brown concretions and many, small, black concretions; strongly acid; clear, wavy boundary.

B'x1—27 to 41 inches, light brownish-gray (10YR 6/2) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) and gray (10YR 6/1) mottles; strong, very coarse, prismatic structure parting to moderate, medium, subangular blocky; firm, brittle and compact; polygonal cracks filled with gray silty material; thick clay films in pores and on some peds; many, large, brown concretions and few, small, black concretions; strongly acid; gradual, wavy boundary.

B'x2—41 to 60 inches, yellowish-brown (10YR 5/6) silty clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/4) mottles; strong, coarse, prismatic structure parting to moderate, medium, subangular blocky; firm, compact and brittle; polygonal cracks filled with gray silty material; clay films on some peds and in pores; many, small, black concretions and concretionary stains on ped surfaces; strongly acid.

Depth to bedrock ranges from 5 to 10 feet or more. The solum is more than 60 inches thick. Depth to the fragipan ranges from 20 to 30 inches. Reaction ranges from medium acid to strongly acid throughout. The Ap horizon is less acid where limed.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 4/3 or 5/3). The B or B&A horizon is yellowish brown (10YR 5/4 or 5/6) or dark yellowish brown (10YR 4/4) and has mottles in shades of gray. The A'2 horizon is light gray (10YR 6/1, 7/1, or 7/2), light brownish gray (10YR 6/2), or grayish brown (10YR 5/2). It has common or many mottles in shades of brown. The B x horizon is light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or yellowish brown (10YR 5/4 or 5/6). It has common or many mottles in shades of brown and gray. It is silt loam or silty clay loam.

Calloway soils are near Loring, Grenada, Sadler, and Belknap soils. They are more poorly drained than Loring, Grenada, and Sadler soils. They differ from Belknap soils in having a fragipan.

Cc—Calloway silt loam. This nearly level soil is on broad ridgetops and on old stream terraces. Areas range from about 5 to more than 150 acres in size. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Grenada soils and soils that are similar in drainage and permeability to the Calloway soil but do not have a fragipan. Also included are areas of soils, mainly in the north-central part of the county, that have a very dark grayish-brown surface layer but are otherwise similar to Calloway soils.

This Calloway soil has a slowly permeable fragipan at a depth of about 20 to 30 inches. The moderately deep root zone is saturated in winter and remains wet into the early part of the growing season.

This soil is suited to soybeans and to pasture and hay plants that withstand wetness, for example tall fescue, lespedeza, and alsike and white clovers. It is only fairly well suited to corn. Tile drainage is not practical, but surface drains reduce wetness in some places. The hazard of erosion is no more than slight.

Most urban uses of this soil are severely limited by wetness. Use for local roads and streets is only moderately limited and for sewage lagoons is slightly limited. Capability unit IIIw-3; woodland group 1w1.

Collins Series

The Collins series consists of deep, nearly level, moderately well drained soils in valleys of flood plains. These soils formed in acid alluvium that washed mostly from soils derived from loess.

In a representative profile the surface layer is brown silt loam about 9 inches thick. The upper 23 inches of the underlying material is friable, yellowish-brown silt loam that is mottled with pale brown and light brownish gray below a depth of 18 inches. The next 9 inches is mottled pale-brown, brown, and light brownish-gray, friable silt loam. The lower part of the underlying material to a depth of 60 inches is light brownish-gray silt loam mottled with pale brown and brown.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is high, and the content of organic matter is low. During wet periods the water table rises to within 24 inches of the surface unless the soil is artificially drained.

Most areas are cleared and used for row crops. Some areas are in pasture. Crops respond well to additions of lime and fertilizer.

Representative profile of Collins silt loam, 150 feet south of Old Morganfield Road, 1.1 miles west of junction with Kentucky Highway 630:

Ap—0 to 9 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; common worm casts; medium acid; clear, smooth boundary.

C1—9 to 18 inches, yellowish-brown (10YR 5/4) silt loam; massive; friable; few roots; few, soft, round, brown concretions; thin bedding planes; strongly acid; gradual, smooth boundary.

C2—18 to 32 inches, yellowish-brown (10YR 5/4) silt loam; common, fine, faint mottles of pale brown (10YR 6/3) and light brownish gray (10YR 6/2); massive; friable; few roots; thin bedding planes; common, soft, small, brown and black concretions; strongly acid; gradual, smooth boundary.

C3—32 to 41 inches, mottled pale-brown (10YR 6/3), brown (10YR 4/3), and light brownish-gray (10YR 6/2) silt loam; massive; friable; thin bedding planes; few roots; common, soft, small, black and brown concretions; strongly acid; gradual, smooth boundary.

C4g—41 to 60 inches, light brownish-gray (10YR 6/2) silt loam; common, pale-brown (10YR 6/3) and brown (10YR 5/3) mottles; massive; friable; thin bedding planes; few roots; many, small, soft, black and brown concretions; strongly acid.

Depth to bedrock is more than 10 feet. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). The C1 horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). The C2 horizon is similar

to the C1 horizon in dominant color and has few to common mottles in shades of gray. The C3 horizon is similar in color to the C1 horizon but, in places, it is mottled in shades of brown and gray and the matrix has a chroma of 2. The C4g horizon ranges from light gray (10YR 7/1) to grayish brown (10YR 5/2) and is mottled in shades of brown.

Collins soils are near the somewhat poorly drained Belknap soils. They are similar to the Steff soils in drainage, but contain less clay.

Co—Collins silt loam. This nearly level soil is along streams and in narrow valleys. It formed in recent alluvium. Areas in the valleys are near upland soils that formed in loess. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Belknap soils and similar soils that are well drained.

This Collins soil is well suited to corn and soybeans as well as to all locally grown grasses, to lespedeza, and to alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Floods occur in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by flooding. Capability unit I-2; woodland group 1w1.

Cuba Series

The Cuba series consists of deep, nearly level, well-drained soils on flood plains in valleys. These soils formed in acid alluvium that washed mostly from soils derived from loess-capped sandstone and shale.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsoil is friable, brown silt loam 20 inches thick. The underlying material to a depth of 60 inches is brown silt loam mottled with very pale brown, yellowish brown, and light gray.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is high, and the content of organic matter is low.

Most areas have been cleared and are used for row crops and pasture. Crop response is good to additions of lime and fertilizer. Some areas are wooded.

Representative profile of Cuba silt loam, 150 yards west of the north end of bridge on Kentucky Highway 70 crossing Tradewater River and 30 yards north of river:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; numerous worm casts in lower part; strongly acid; abrupt, smooth boundary.

B2—8 to 28 inches, brown (10YR 4/3) silt loam; weak, fine, subangular blocky structure; friable; few roots; strongly acid; clear, smooth boundary.

C1—28 to 40 inches, brown (10YR 4/3) silt loam; few, fine, distinct mottles of very pale brown (10YR 7/3); massive; friable; few roots; strongly acid; gradual, smooth boundary.

C2—40 to 60 inches, brown (10YR 4/3) silt loam; many, fine and medium, distinct mottles of light gray (10YR 7/2) and yellowish brown (10YR 5/6); massive; friable; few roots; thin bedding planes; few, small, soft, round, black concretions; strongly acid.

Depth to bedrock is more than 10 feet. The solum ranges from 20 to 40 inches in thickness. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed.

The A horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The B horizon ranges from pale brown (10YR 6/3) to dark yellowish brown (10YR 4/4). In some places the soil is mottled below a depth of 27 inches. The C horizon is similar in color to the B horizon.

Cuba soils are near the moderately well drained Steff soils and the somewhat poorly drained Stendal soils.

Cu—Cuba silt loam. This nearly level soil is along streams and in narrow valleys. It formed in recent alluvium. Areas in the valleys are near upland soils that formed in material weathered from acid sandstone and shale. Slope is 0 to 2 percent.

Included with this soil in mapping are a few areas of Steff soils and soils that have a subsoil of loam or fine sandy loam. Also included are a few areas of soils along the Green River that are similar to the Cuba soil but are less acid.

This Cuba soil is well suited to corn and soybeans as well as to all locally grown grasses, to lespedeza, and to alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Floods occur in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by flooding. Because the soil is along larger perennial streams, it has potential for picnic areas and trails. It is very rarely flooded during the season of these uses. Capability unit I-1; woodland group 1o1.

Frondorf Series

The Frondorf series consists of moderately steep to steep, well-drained soils that are moderately deep over bedrock. These soils are on hillsides on uplands. The areas are highly dissected by intermittent drainageways. The soils formed in a thin mantle of loess and in the underlying material weathered from acid sandstone and shale.

In a representative profile the surface layer is dark grayish-brown silt loam about 1 inch thick. The subsurface layer is brown silt loam 3 inches thick. The subsoil is 26 inches thick. The upper 11 inches is friable, yellowish-brown silt loam, the next 10 inches is firm, strong-brown channery clay loam, and the lower 5 inches is friable, strong-brown channery loam. Fine-grained sandstone bedrock is at a depth of 30 inches.

These soils have a moderately deep root zone. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability and the available water capacity are moderate. The content of organic matter is low.

Most areas are wooded or are idle. Some areas are cleared and used for pasture. Crop response is fair to additions of lime and fertilizer.

Representative profile of Frondorf silt loam in an area of Frondorf-Lenberg silt loams, 12 to 30 percent slopes, 100 feet west of gravel road, 2.5 miles north of U.S. Highway 41A at Mitchell Hill, and 4 miles northeast of Madisonville:

A1—0 to 1 inch, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; very friable; many roots; very strongly acid; abrupt, smooth boundary.

A2—1 to 4 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; very friable; many roots; very strongly acid; clear, smooth boundary.

B21t—4 to 15 inches, yellowish-brown (10YR 5/4) heavy silt loam; weak, medium, subangular blocky structure; friable; common roots; common, thin clay films; very strongly acid; gradual, smooth boundary.

IIB22t—15 to 25 inches, strong-brown (7.5YR 5/6) channery silty clay loam; weak, medium, subangular blocky structure; firm; few roots; common clay films; 25 percent sandstone fragments; very strongly acid; gradual, wavy boundary.

IIB3—25 to 30 inches, strong-brown (7.5YR 5/6) channery loam; weak, medium, subangular blocky structure; friable; 50 percent

sandstone fragments; very strongly acid; clear, smooth boundary.
IIR—30 inches, fine-grained sandstone.

Thickness of solum and depth to bedrock range from 20 to 40 inches. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed. Content of coarse fragments ranges from 0 to 5 percent to a depth of 12 to 24 inches and from 15 to 60 percent below that depth.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or brown (10YR 4/3). The A2 horizon ranges from grayish brown (10YR 5/2) to pale brown (10YR 6/3). The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). A thin B1 horizon occurs in places. The B horizon ranges from brown (7.5YR 4/4) to brownish yellow (10YR 6/6). The B21t horizon is silt loam or silty clay loam. The B3 horizon is silt loam, silty clay loam, silty clay, loam, or sandy clay loam, or their channery analogues. The C horizon is the same color and texture as the B3 horizon.

Frondorf soils are near Wellston, Lenberg, and Steinsburg soils. They contain less clay in the lower part of the B horizon than Lenberg soils and less sand in the B horizon than Steinsburg soils. Frondorf soils are less than 40 inches deep over bedrock, but Wellston soils are more than 40 inches deep over bedrock.

FdE—Frondorf-Lenberg silt loams, 12 to 30 percent slopes. This mapping unit is about 40 percent Frondorf soil, 20 percent Lenberg soil, and 40 percent other soils. Both the Frondorf soil and the Lenberg soil have the profile described as representative for their respective series.

Included with this unit in mapping are Wellston soils, which make up about 15 percent of mapped areas, and Steinsburg soils, which make up 10 percent. Also included in mapping are small areas of soils similar to Frondorf and Lenberg soils that are less than 20 inches deep over bedrock, small areas of Collins soils, and small areas of rock outcrop. Frondorf and Lenberg soils that have a surface layer of loam, fine sandy loam, or silty clay are included.

Most areas are wooded or are idle. Some areas are cleared and used for pasture. The unit is not suited to cultivated crops because slopes are steep and the risk of erosion is severe. It is suited to pasture and woodland. Tall fescue and lespedeza grow well. Hay and pasture crops must provide a good plant cover to slow runoff and reduce erosion.

Most urban uses are severely limited by steep slopes and moderate depth to bedrock. Nature areas and hiking trails are a potential use. Capability unit VIe-1; woodland group 2r1 (N), 3r1 (S).

Grenada Series

The Grenada series consists of gently sloping, moderately well drained soils that have a fragipan. These soils are on broad ridgetops on uplands and on stream terraces in valleys. The soils on uplands formed in loess more than 4 feet thick, and those on terraces formed in alluvium washed mostly from soils derived from loess.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The upper 17 inches of the subsoil is friable, yellowish-brown silt loam. The next 4 inches is friable, light-gray silt loam mottled with yellowish brown. The lower part of the subsoil to a depth of 60 inches is a fragipan of yellowish-brown and gray silty clay loam and silt loam that is mottled in shades of brown and gray.

These soils have a moderately deep root zone where they are uneroded. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. The content of organic matter is low.

Most areas are cleared and used for row crops and pasture. Crops respond well to additions of lime and fertilizer. Some areas are wooded or are idle.

Representative profile of Grenada silt loam, 2 to 6 percent slopes, 350 feet south of old Morganfield Road, 1.5 miles west of junction with Kentucky Highway 630:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.
B21—8 to 15 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak, fine, angular and subangular blocky structure; friable; many roots and pores; strongly acid; clear, smooth boundary.
B22—15 to 25 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, faint mottles of pale brown (10YR 6/3); moderate, fine, subangular blocky structure; friable; few roots; few, small, round, soft, brown concretions; strongly acid; clear, wavy boundary.
A'2—25 to 29 inches, light-gray (10YR 7/2) silt loam; many, fine, distinct mottles of yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2); weak, fine, subangular blocky structure; friable; few roots and pores; many, small, round, light-brown concretions and soft concretionary material; strongly acid; abrupt, smooth boundary.
B'x1—29 to 41 inches, yellowish-brown (10YR 5/6) silty clay loam; many, medium, distinct mottles of gray (10YR 6/1) and light brownish gray (10YR 6/2); weak, very coarse, prismatic structure parting to moderate, fine and medium, subangular blocky; firm, compact and brittle; few, small, round, soft concretions; thick clay films; tongues of gray silty material between prisms; strongly acid; gradual, wavy boundary.
B'x2—41 to 60 inches, mottled gray (10YR 6/1), brown (10YR 4/3), and yellowish-brown (10YR 5/6) silt loam; weak, very coarse, prismatic structure parting to weak, medium, subangular blocky; firm, compact and brittle; few, thin, patchy clay films; tongues of gray silty material between prisms; strongly acid.

Depth to bedrock ranges from 5 to more than 10 feet. The solum is commonly more than 60 inches thick. Reaction is strongly acid to very strongly acid. The Ap horizon is less acid where limed. Depth to the fragipan ranges from 20 to 32 inches.

The A horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The B horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4 or 5/6) and in places is mottled with pale brown (10YR 6/3) in the lower part. This horizon ranges from heavy silt loam to light silty clay loam. The A'2 horizon ranges from gray (10YR 5/1) to very pale brown (10YR 7/3) and is mottled in shades of brown. The B'x horizon is brown (10YR 5/3), yellowish brown (10YR 5/4 or 5/6), or dark yellowish brown (10YR 4/4) and is mottled in shades of gray or in shades of gray, yellow, or brown. This horizon is heavy silt loam or light silty clay loam.

Grenada soils are near the somewhat poorly drained Calloway soils and the moderately well drained Loring soils. They have an A'2 horizon that is lacking in the Loring soils. They are similar in drainage to Sadler soils but are more than 48 inches deep over sandstone and shale residuum.

GnB—Grenada silt loam, 2 to 6 percent slopes. This soil is on broad, smooth uplands and on long, winding terraces 200 to 400 feet wide. Areas range from about 5 to 90 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of Calloway and Loring soils. Also included are a few areas of soils that have a very dark grayish-brown surface layer less than 9 inches thick but are otherwise similar to Grenada soils.

This Grenada soil is moderate in natural fertility. It is easy to till. Because it has a fragipan, the root zone is only moderately deep and is saturated in winter and early in spring.

This soil is well suited to most crops grown in the county.

Corn, soybeans, tobacco, and small grains grow well under a high level of management. Some pasture and hay plants that grow well are all locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is moderate in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops should provide a good plant cover.

Use of this soil for septic tank filter fields is severely limited by the slowly permeable fragipan. Most other urban uses are moderately limited. Capability unit IIIe-3; woodland group 4o1.

GnB3—Grenada silt loam, 2 to 6 percent slopes, severely eroded. This soil is in areas dissected by small gullies. Slopes are 200 to 300 feet long. The soil has a profile similar to the one described as representative of the series, but more than 50 percent of the surface layer is eroded and the fragipan is within 15 to 18 inches of the surface.

Included with this soil in mapping are a few areas of severely eroded Loring and Sadler soils.

This Grenada soil is low in natural fertility. It is moderately easy to till. Because the depth to the fragipan is shallow, the root zone is shallow and is saturated in winter and early in spring.

This soil is suited to shallow-rooted crops such as soybeans and small grains grown under a high level of management. Some hay and pasture plants that grow well are tall fescue, lespedeza, and white clovers. The hazard of erosion is severe in cultivated areas. A suitable cropping system, erosion control, and a good plant cover are needed.

Use of this soil for septic tank filter fields is severely limited by the slowly permeable fragipan. Most other urban uses are moderately limited. Capability unit IIIe-3; woodland group 4o1.

Gullied Land

Gu—Gullied land is so dissected by deep gullies that the original soil profile has been destroyed except in narrow strips between the gullies. Slope ranges from 10 to 30 percent. Gullied land is very low in natural fertility and content of organic matter. It is strongly acid to very strongly acid. Included in mapping are areas of Zanesville, Wellston, and Loring soils between the gullies.

Most areas have been abandoned for farming. A few areas that have been reclaimed by grading and smoothing are used as limited pasture. Many areas are planted to trees.

Gullied land is not suited to cultivated crops, and most areas are not suited to pasture. The best uses are woodland and wildlife.

Most urban uses are severely limited by slope and irregular topography. Capability unit VIIe-3; not assigned to a woodland group.

Karnak Series

The Karnak series consists of deep, nearly level, poorly drained soils in broad valleys near major streams on flood plains. These soils formed in clayey, slack-water deposits.

In a representative profile the surface layer is dark grayish-brown silty clay about 8 inches thick. The subsoil is 24 inches thick. It is very firm, gray silty clay mottled with yellowish brown and dark grayish brown. The underlying material to a depth of 60 inches is gray clay that is mottled with yellowish brown and strong brown.

These soils have a deep root zone. Unless limed, they are medium acid to slightly acid in the surface layer. Permeability is slow, and the available water capacity is high. Natural fertility is moderate, and the content of organic matter is low. The water table is at or near the surface during periods of heavy rain unless the soils are artificially drained.

About 70 percent of the acreage is cleared and used for row crops. In drained areas, crops respond well to additions of lime and fertilizer. Some areas are wooded.

Representative profile of Karnak silty clay, 350 feet south of Kentucky Highway 85, 1.5 miles west of Pond River bridge:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay; few, fine, distinct mottles of strong brown (7.5YR 5/6); weak, fine, subangular blocky structure; firm, plastic and sticky; many roots; slightly acid; abrupt, smooth boundary.

B21g—8 to 12 inches, mottled dark grayish brown (10YR 4/2), gray (10YR 5/1), and yellowish-brown (10YR 5/6) silty clay; weak, fine and medium, subangular blocky structure; very firm; many roots; medium acid; clear, smooth boundary.

B22g—12 to 32 inches, gray (10YR 5/1) silty clay; many, fine, distinct mottles of yellowish brown (10YR 5/6); weak, fine and medium, angular and subangular blocky structure; very firm; few roots; few, small, round, brown concretions; slightly acid; gradual, smooth boundary.

Cg—32 to 60 inches, gray (10YR 5/1) clay, many, fine, distinct mottles of yellowish brown (10YR 5/6) and strong brown (7.5 YR 5/6); massive; very firm; slightly acid; neutral in lower part.

Depth to bedrock is more than 12 feet. The solum ranges from 30 to 60 inches in thickness. Reaction ranges from medium acid to slightly acid in the solum and from medium acid to neutral in the C horizon.

The A horizon is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2) and has few to common gray and brown mottles. The Bg horizon ranges from dark gray (10YR 4/1) to light gray (2.5Y 7/2) and has few to many mottles in shades of brown and yellow. This horizon is silty clay or clay. The Cg horizon is similar to the Bg horizon in color and texture.

Karnak soils are near the somewhat poorly drained McGary soils and the well drained to moderately well drained Markland soils.

Kb—Karnak silt loam, overwash. This nearly level soil is at the edge of broad valleys near upland soils that formed in loess. It formed in clayey, slack-water deposits that have an overwash of silty alluvium. Slope is 0 to 2 percent. The soil has a profile similar to the one described as representative of the series, but the upper 6 to 20 inches is silt loam.

Included with this soil in mapping are a few small areas of Karnak silty clay or silty clay loam and small areas of Belknap soils.

This Karnak soil is easily tilled. It is suited to plants that withstand wetness. If adequately drained, the soil is well suited to corn, soybeans, all locally grown grasses, lespedeza, and alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Flooding occurs occasionally in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by wetness and flooding. Capability unit IIIw-5; woodland group 1w2.

Kc—Karnak silty clay. This nearly level soil is in broad valleys of major streams. It formed in clayey, slack-water deposits. Areas range from about 25 to more than 1,000

acres in size. Slope is 0 to 2 percent. The soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of McGary soils and a few areas of soils that have a very dark grayish-brown surface layer less than 9 inches thick but are otherwise similar to Karnak soils. Also included are a few areas of Karnak silty clay loam.

This soil has a clayey surface layer and subsoil. It is difficult to till and can be worked only within a narrow range of moisture conditions.

This soil is suited to plants that tolerate wetness. If artificial drainage is adequate, it is well suited to corn, soybeans, lespedeza, tall fescue, and alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Flooding occurs in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by wetness, flooding, and the heavy texture. Capability unit IIIw-4; woodland group 1w2.

Lenberg Series

The Lenberg series consists of moderately steep to steep, well-drained soils that are moderately deep over bedrock. These soils are on hillsides on uplands. The areas are highly dissected by intermittent drainageways. The soils formed in material weathered from acid shale and sandstone.

In a representative profile the surface layer is dark-brown silt loam about 5 inches thick. The subsurface layer is brown silt loam 5 inches thick. The subsoil is 16 inches thick. The upper 6 inches is firm, yellowish-brown silty clay loam, and the lower 10 inches is firm, yellowish-brown channery silty clay mottled with light brownish gray and light yellowish brown. The underlying material is strong-brown channery silty clay 8 inches thick. Acid shale bedrock is at a depth of 34 inches.

These soils have a moderately deep root zone. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is slow to moderate, and the available water capacity is moderate. The content of organic matter is low.

Most areas are wooded or are idle. Some areas are cleared and used for pasture. Crop response is fair to additions of lime and fertilizer.

Lenberg soils are mapped only in a complex with Frondorf soils.

Representative profile of Lenberg silt loam in an area of Frondorf-Lenberg silt loams, 12 to 30 percent slopes, 300 feet east of Ed Lacey Road, ⅝ mile north of Kentucky Highway 70, 4 miles west of Beulah:

A1—0 to 5 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; strongly acid; abrupt, smooth boundary.

A2—5 to 10 inches, brown (10YR 5/3) silt loam; moderate, fine, granular structure; friable; many roots; 10 percent sandstone fragments; strongly acid; clear, wavy boundary.

IIB21t—10 to 16 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; thin, patchy clay films on ped surfaces; common roots; 10 percent sandstone and shale fragments; strongly acid; gradual, wavy boundary.

IIB22t—16 to 26 inches, yellowish-brown (10YR 5/6) channery silty clay; few, fine, faint, light yellowish-brown (2.5Y 6/4) and light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy clay films; common roots; 20 percent soft shale fragments; strongly acid; clear, smooth boundary.

IIC—26 to 34 inches, strong-brown (7.5YR 5/6) channery silty clay; few, fine, distinct, gray (10YR 6/1) mottles; massive; firm; 40 percent soft shale fragments; few roots; strongly acid; clear, smooth boundary.

IIR—34 inches, acid clay shale.

Depth to weathered clayey shale and solum thickness is 20 to 40 inches. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed. Coarse fragments range from 0 to 30 percent throughout the solum.

The A1 or Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). The A2 horizon is brown (10YR 5/3), pale-brown (10YR 6/3), or light yellowish-brown (10YR 6/4) silt loam or loam. Colluvial material as much as 12 inches thick is on the surface in places. The Bt horizon ranges from yellowish brown (10YR 5/4) to reddish yellow (7.5YR 6/6), and the lower part has few to common mottles in shades of gray and brown. This horizon ranges from silty clay loam to clay or their channery analogues. The C horizon is acid, gray or brownish-clay shale.

Lenberg soils are near the deep Wellston soils and the less clayey Frondorf soils.

Loring Series

The Loring series consists of gently sloping to sloping, moderately well drained soils that have a fragipan. These soils are on narrow ridgetops and side slopes on uplands. They formed in loess more than 4 feet thick.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The subsoil is 38 inches thick. The upper 5 inches is friable, brown silt loam. The next 16 inches is friable and firm, strong-brown silty clay loam that is mottled with pale brown in the lower part. The lower 17 inches is a fragipan of very firm, brown and strong-brown silty clay loam and silt loam that is mottled with light gray. The underlying material to a depth of 60 inches is strong-brown silt loam that is mottled with pinkish gray.

These soils are easy to till. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. The content of organic matter is low.

Most areas are cleared and used for row crops and pasture. Crops respond well to additions of lime and fertilizer. Some areas are wooded or are idle.

Representative profile of Loring silt loam, 2 to 6 percent slopes, 450 yards south of U.S. Highway 41A, 0.8 mile west of its junction with Kentucky Highway 1089:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many roots; slightly acid; clear, smooth boundary.

B1—7 to 12 inches, brown (7.5YR 4/4) silt loam; weak, very fine, angular and subangular blocky structure; friable; many roots; many small pores; strongly acid; clear, smooth boundary.

B21t—12 to 20 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, angular and subangular blocky structure; friable; discontinuous clay films; many roots; few small pores; few, small, soft, brown, round concretions; strongly acid; gradual, smooth boundary.

B22t—20 to 28 inches, strong-brown (7.5YR 5/6) silty clay loam; few, fine, faint, pale-brown (10YR 6/3) mottles; strong, fine and medium, angular and subangular blocky structure; firm; common roots; few pores; discontinuous clay films; strongly acid; clear, smooth boundary.

Bx1—28 to 36 inches, brown (7.5YR 4/4) light silty clay loam; many, medium, distinct mottles of pale brown (10YR 6/3); weak, very

coarse, prismatic structure parting to strong, medium and coarse, angular blocky; very firm, compact and brittle; gray silt coats in cracks between prisms; few roots in cracks; few, medium, soft, round, brown concretions; discontinuous clay films; strongly acid; clear, smooth boundary.

Bx2—36 to 45 inches, strong-brown (7.5YR 5/6) silt loam; many, medium, distinct mottles of light gray (10YR 7/2); weak, very coarse, prismatic structure parting to weak, medium, subangular blocky; very firm, compact and brittle; gray silt coatings in cracks between prisms; many, small, soft, round, brown concretions; strongly acid; clear, smooth boundary.

C—45 to 60 inches, strong-brown (7.5YR 5/6) silt loam; many, pinkish-gray (7.5YR 6/2) mottles; massive; few, small, round, brown concretions; strongly acid.

Depth to bedrock ranges from 5 to more than 10 feet. The solum ranges from 45 to 60 inches in thickness. Reaction ranges from strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed. Depth to the fragipan ranges from 24 to 35 inches.

The A horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3), or dark yellowish brown (10YR 4/4). The Bt horizon ranges from brown (7.5YR 4/4) to yellowish brown (10YR 5/6) and has few gray or pale-brown mottles in the lower part. The Bx horizon is similar in color to the Bt horizon and has common to many gray, brown, or yellow mottles. The C horizon is similar in color to the Bt horizon and has few to many mottles in shades of gray.

Loring soils are near the somewhat poorly drained Calloway soils and the moderately well drained Grenada soils. They lack the A'2 horizon of the Grenada soils. They are similar to the Zanesville soils but are more than 48 inches deep over sandstone and shale residuum.

LoB—Loring silt loam, 2 to 6 percent slopes. This soil is mainly on ridgetops. It occupies winding areas 200 to 500 feet wide that range from 5 to 75 acres in size. Slopes are convex. The soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of severely eroded Loring soils and small areas of Grenada soils.

This Loring soil is moderate in natural fertility. Because it has a fragipan, the root zone is only moderately deep.

This soil is well suited to most crops grown in the county. Corn, soybeans, tobacco, and small grain grow well under a high level of management. Some pasture and hay plants that grow well are all locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is moderate in cultivated areas. A suitable cropping system and erosion control practices are needed. Hay and pasture crops must provide a good plant cover.

Use of this soil for septic tank absorption fields is severely limited by the slowly permeable fragipan. Picnic and camp areas are well suited. Most other urban uses are moderately limited. Capability unit IIe-2; woodland group 3o1.

LoC—Loring silt loam, 6 to 12 percent slopes. This soil is in areas dissected by drainageways. Areas range from 5 to 40 acres in size. Slopes are 150 to 500 feet long.

Included with this soil in mapping are a few small areas of severely eroded Loring soils and small areas of Grenada soils.

This Loring soil is moderate in natural fertility. Because it has a fragipan, the root zone is only moderately deep.

This soil is well suited to most crops grown in the county. Corn, soybeans, tobacco, and small grain grow well under a high level of management. Some hay and pasture plants that grow well are all locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

The use of this soil for septic tank absorption fields is severely limited by the slowly permeable fragipan. Use for sewage lagoons is severely limited by slope. Most other urban uses are moderately limited. Capability unit IIIe-2; woodland group 3o1.

LoC3—Loring silty clay loam, 6 to 12 percent slopes, severely eroded. This soil is in areas dissected by drainageways. Areas range from 5 to 30 acres in size. Slopes are 150 to 500 feet long. The soil has a profile similar to the one described as representative of the series, but more than 50 percent of the surface layer has been removed by erosion.

Included with this soil in mapping are a few areas of uneroded Loring soils and areas of Loring silt loam, 2 to 6 percent slopes. Also included are small areas of Grenada and Wellston soils.

The Loring soil is moderately low in natural fertility. Because it has a fragipan, the root zone is only moderately deep.

This soil is suited only to occasional cultivation because runoff is excessive and further erosion is a risk. It is better suited to pasture and hay crops than to row crops. Tall fescue, lespedeza, and alsike and red and white clovers grow well. The hazard of erosion is very severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

Use of this soil for septic sank absorption fields is severely limited by the slowly permeable fragipan. Use for sewage lagoons is severely limited by slope. Most other urban uses are moderately limited. Capability unit IVe-4; woodland group 4o1.

Markland Series

The Markland series consists of deep, sloping to very steep, moderately well drained to well drained soils on stream terraces. These soils occur as narrow bands along small streams. They formed in clayey, slack-water deposits.

In a representative profile the surface layer is dark grayish-brown silty clay about 3 inches thick. The subsurface layer is brown silty clay 5 inches thick. The subsoil is 36 inches thick. The upper 6 inches is firm, yellowish-brown silty clay, and the lower 30 inches is very firm, brown clay. The underlying material to a depth of 60 inches is yellowish-brown clay that is mottled with gray and brown.

These soils have a deep root zone and are moderately easy to till. Unless limed, they range from strongly acid in the surface layer to moderately alkaline in the lower part of the subsoil. Permeability is slow in the clayey subsoil. The available water capacity is high. Natural fertility is moderate, and the content of organic matter is low.

Most areas are wooded. A few areas have been cleared and are used for crops or are idle. Crop response is fair to additions of lime and fertilizer.

Representative profile of Markland silty clay, 6 to 12 percent slopes, severely eroded, 450 yards south of Pitman Creek, 1.6 miles southwest of confluence with Green River:

O—0 to 1 inch, partly decomposed leaves and twigs.

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) silty clay; mod-

erate, fine, granular structure; friable; many roots; strongly acid; abrupt, smooth boundary.

A2—3 to 8 inches, brown (10YR 5/3) silty clay; moderate, medium, granular structure; friable; many roots; strongly acid; clear, smooth boundary.

B1t—8 to 14 inches, yellowish-brown (10YR 5/4) silty clay; moderate, fine, subangular blocky structure; firm; few, thin, discontinuous clay films; many roots; strongly acid; clear, smooth boundary.

B2t—14 to 44 inches, brown (10YR 4/3) clay; few, fine, faint, yellowish-brown (10YR 5/4) mottles in lower part; strong, fine and medium, angular blocky structure; very firm; thin, dark-brown clay films; few roots; slightly acid; clear, wavy boundary.

C—44 to 60 inches, yellowish-brown (10YR 5/4) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) and light brownish-gray (10YR 6/2) mottles; massive; firm; mildly alkaline; calcareous.

Depth to bedrock ranges from 6 feet to more than 12 feet. The solum ranges from 30 to 44 inches in thickness.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4). It is silty clay or silty clay loam and is strongly acid unless limed. The B1 horizon is similar to the Ap horizon in color, texture, and reaction. The B2 horizon is brown (10YR 4/3 or 5/3), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4) and in places is mottled in the lower part. This horizon is silty clay or clay and is slightly acid to strongly acid. The C horizon ranges from brown (10YR 4/3) to light olive brown (2.5Y 5/4 or 5/6) and has few to many mottles in shades of brown and gray. It is silty clay or clay and is mildly to moderately alkaline and calcareous.

Markland soils are near the somewhat poorly drained McGary soils and the poorly drained Karnak soils.

MbC3—Markland silty clay, 6 to 12 percent slopes, severely eroded. This soil is at the edge of small drainageways. Areas range from about 5 to 40 acres in size. Slopes are 150 to 300 feet long. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are a few areas where the surface layer is silt loam or silty clay loam 2 to 8 inches thick. Also included are a few small areas of McGary soils.

This Markland soil is suited only to occasional cultivation, because runoff is excessive and further erosion is a risk. It is better suited to hay and pasture crops than to row crops. Tall fescue and white clovers grow well. The hazard of erosion is very severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

Most urban uses are severely limited by slow permeability and high shrink-swell potential. Use for picnic areas and campsites is moderately limited. Capability unit IVe-2; woodland group 2c1.

ME—Markland-Collins complex. This mapping unit is about 60 percent Markland silty clay loam, 25 percent Collins silt loam, and 15 percent other soils. The Markland soil is mainly moderately steep to very steep, and slope is 12 to 50 percent. The Collins soil is nearly level, and slope is 0 to 2 percent. The Markland soil has a profile similar to the one described as representative of the series, but the subsoil is more acid and the surface layer and subsoil are more than 44 inches thick. The Collins soil has a profile similar to the one described as representative of the Collins series, but the subsoil ranges from medium acid to neutral.

Included with this unit in mapping are small areas of soils similar to Steff silt loam.

Practically all areas are wooded. The unit is best suited to woodland and wildlife. It is not suited to cultivated crops or pasture.

Urban development is severely limited by flooding on the Collins soil and by the steep slopes of the Markland soil. Capability unit VIIe-2; woodland group 2c1.

McGary Series

The McGary series consists of nearly level, somewhat poorly drained soils that have a clayey subsoil. These soils are on stream terraces in broad valleys near major streams and their tributaries. They formed in clayey, slack-water deposits.

In a representative profile the surface layer is grayish-brown silt loam about 6 inches thick. The upper 13 inches of the subsoil is firm, gray silty clay mottled with yellowish brown. The lower 24 inches is extremely firm, mottled gray and yellowish-brown silty clay. The underlying material to a depth of 60 inches is light olive-brown clay that is mottled with gray.

These soils have a moderately deep root zone and are moderately easy to till. Unless limed, they range from strongly acid in the surface layer to neutral in the lower part of the subsoil. Permeability is slow or very slow, and the available water capacity is moderate. Natural fertility and the content of organic matter are low.

More than half of the acreage is wooded. Areas that are cleared are used for row crops or are idle. Crop response is fair to additions of lime and fertilizer.

Representative profile of McGary silt loam, 650 yards north of Kentucky Highway 85, 1,000 yards east of Pond River:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam; weak, fine, granular structure; friable; strongly acid; clear, smooth boundary.

B21gt—6 to 19 inches, gray (10YR 6/1) silty clay; many, fine and medium, distinct yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, angular blocky structure; firm; common roots; thin, patchy clay films; strongly acid; clear, smooth boundary.

B22gt—19 to 24 inches, gray (10YR 6/1) silty clay; many, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular blocky structure; very firm; thin, patchy clay films; few roots; strongly acid; clear, smooth boundary.

B3gt—24 to 43 inches, mottled gray (10YR 6/1) and yellowish-brown (10YR 5/4) silty clay; weak, fine, angular blocky structure; extremely firm; few roots; medium acid; clear, smooth boundary.

C—43 to 60 inches, light olive-brown (2.5Y 5/4) clay; many, fine, distinct mottles of gray (10YR 6/1) and light olive brown (2.5Y 5/6); massive; extremely firm; few, small, soft, black concretions; medium acid.

Depth to bedrock ranges from 6 to 12 feet or more. The solum ranges from 30 to 50 inches in thickness.

The Ap horizon is dark gray (10YR 4/1), grayish brown (10YR 5/2), or gray (10YR 5/1). It is strongly acid to medium acid depending on amount of lime applied. The B horizon is gray (10YR 5/1 or 6/1), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) and is mottled in shades of brown or gray. It ranges from strongly acid in the upper part to slightly acid in the lower part. The C horizon ranges from gray (10YR 6/1) to light olive brown (2.5Y 5/6) and has many mottles in shades of gray and brown. It is medium acid to neutral.

McGary soils are near the poorly drained Karnak soils and the well drained and moderately well drained Markland soils.

Mg—McGary silt loam. This nearly level soil is on broad, low-lying terraces. It formed in clayey, slack-water deposits. Areas range from 10 to 300 acres in size. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Karnak and Calloway soils. Also included are small areas of a McGary silt loam that has 2 to 4 percent slopes.

This soil has a slowly permeable or very slowly permeable subsoil. The moderately deep root zone is saturated in winter and remains wet well into the growing season.

This soil is suited to pasture and hay plants that withstand wetness; for example, tall fescue, lespedeza, and white clover. It is moderately suited to soybeans. Tile drainage is not practical, but surface drains reduce wetness in some places. The hazard of erosion is no more than slight.

Most urban uses of this soil are severely limited by slow or very slow permeability and high shrink-swell potential. Use for sewage lagoons is slightly limited. Capability unit IIIw-2; woodland group 3w1.

McGary Variant

The McGary variant consists of deep, nearly level, somewhat poorly drained soils on stream terraces in broad valleys. These soils formed in alluvium washed mostly from soils weathered from sandstone and shale and in the underlying clayey, slack-water sediments.

In a representative profile the surface layer is brown loam about 7 inches thick. The upper 6 inches of the subsoil is friable, brown loam, the next 13 inches is firm, gray sandy clay loam mottled with yellowish brown, and the lower 13 inches is mottled gray and yellowish-brown sandy clay. The underlying material to a depth of 60 inches is mottled gray and strong-brown sandy clay.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is moderate, and the content of organic matter is low. The water table rises to within about 12 inches of the surface during wet periods unless the soils are artificially drained.

Most areas are cleared and used for row crops. Crops respond well to additions of lime and fertilizer.

Representative profile of McGary loam, loamy subsoil variant, 0.75 mile north of confluence of Earle Creek with Pond River, 550 yards south of L&N Railroad:

Ap—0 to 7 inches, brown (10YR 5/3) loam; weak, fine, granular structure; friable; common roots; strongly acid; clear, smooth boundary.

B1—7 to 13 inches, brown (10YR 5/3) loam; few, fine, distinct mottles of yellowish brown (10YR 5/6); weak, medium, subangular blocky structure; friable; common roots; few large pores (worm holes); few, small, soft, brown concretions; strongly acid; clear, smooth boundary.

B21t—13 to 26 inches, gray (10YR 6/1) heavy sandy clay loam; many, medium, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, angular and subangular blocky structure; firm; few roots; few, thin, patchy clay films; few, soft, round, brown concretions; many, small pores; strongly acid; clear, smooth boundary.

B22t—26 to 36 inches, mottled gray (10YR 6/1) and yellowish-brown (10YR 5/6) sandy clay; moderate, medium, subangular blocky structure; firm; thin, continuous clay films; strongly acid; clear, smooth boundary.

C—36 to 60 inches, mottled gray (10YR 6/1) and strong-brown (7.5YR 5/6) sandy clay; massive; firm; few soft black concretions, few mica flakes; strongly acid.

Depth to bedrock is 6 to 12 feet or more. The solum ranges from 30 to 40 inches in thickness. Reaction is strongly to very strongly acid throughout. The Ap horizon is less acid where limed.

The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 4/3 or 5/3). The B1 horizon is brown (10YR 5/3 or 10YR 4/3) and has few to common gray and yellowish-brown mottles. This horizon is loam or light sandy clay loam. The B2t horizon is light gray (10YR 6/1) or light brownish gray (10YR 6/2) and is mottled in shades of brown. This horizon is loam, sandy clay loam, or sandy loam in the upper part and sandy clay loam, clay loam, or sandy clay in the lower part. The C horizon is similar in color to the B2t horizon. It is clay loam, sandy clay, or clay.

The McGary variant is near Calloway, Belknap, and Karnak soils. It lacks the fragipan of Calloway soils and contains more sand in the B horizon than Belknap or Karnak soils.

Mh—McGary loam, loamy subsoil variant. This nearly level soil is on broad terraces near upland soils that formed in material weathered from sandstone. Areas range from 5 to 100 acres in size. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of similar soils where the surface layer and subsoil combined are more than 40 inches thick and similar soils that have a surface layer of fine sandy loam. Also included are a few small areas of Calloway soils.

This McGary variant is well suited only to row crops and pasture and hay plants that withstand wetness. If artificially drained, it is well suited to corn and soybeans as well as to all the locally grown grasses, to lespedeza, and to alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Floods occur occasionally in winter and early in spring, but seldom if ever during the growing season. Wetness, the main limitation, can be reduced by artificial drainage.

Most urban uses of this soil are severely limited by flooding and wetness. Capability unit IIw-2; woodland group 2w1.

Mine Dump

Mn—Mine dump is waste material from coal mines, mostly coal dust and black, slatelike fragments. This material, which is brought out of the mines with the coal, is separated from the coal as impurities at the tipple. In some areas, it is stacked in large piles as solids, and in others it is pumped into pits or ponds as slurry.

This material is extremely acid and is generally devoid of vegetation. Reclamation would be costly and impractical. Most urban use is severely limited. Not assigned to a capability unit or a woodland group.

Mine Wash

Mw—Mine wash is waste material washed from coal mining areas, particularly from around tipples where coal is washed. This material is mostly coal dust and impurities that have been separated from coal. It ranges from 15 inches to 5 or more feet thick. It is underlain by silty alluvium washed from the sandstone and shale uplands.

This material is extremely acid and is devoid of vegetation. Reclamation would be very costly and impractical. Most urban use is severely limited by flooding. Not assigned to a capability unit or woodland group.

Otwell Series

The Otwell series consists of gently sloping, well drained and moderately well drained soils that have a fragipan. These soils are on stream terraces along the Green River

and the Pond River. They formed in old acid alluvium that washed mostly from soils derived from sandstone, shale, and loess.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The subsoil is 41 inches thick. The upper 13 inches is firm, yellowish-brown silty clay loam that is mottled with brown and pale brown in the lower part. The lower 28 inches is a fragipan. It is 12 inches of very firm, brown silty clay loam mottled with light brownish gray and 16 inches of firm, dark yellowish-brown silty clay loam mottled with gray. The underlying material to a depth of 65 inches is dark yellowish-brown silty clay loam that is mottled with gray.

These soils have a moderately deep root zone. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. The content of organic matter is low.

About half of the acreage has been cleared and is used for row crops. Crops respond well to additions of lime and fertilizer. The rest of the areas are wooded or are idle.

Representative profile of Otwell silt loam, 2 to 6 percent slopes, 400 feet west of Pond River, 2 miles south of Kentucky Highway 281:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many fine roots; strongly acid; clear, smooth boundary.

B21t—7 to 16 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; few fine roots; thin patchy clay films on ped faces and in pores; very strongly acid; gradual, smooth boundary.

B22t—16 to 20 inches, yellowish-brown (10YR 5/6) silty clay loam; common, fine, distinct, pale-brown (10YR 6/3) mottles and few, fine, faint, brown (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; common clay films; very strongly acid; clear, smooth boundary.

Bx1—20 to 25 inches, brown (7.5YR 4/4) silty clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; moderate, very coarse, prismatic structure parting to weak, coarse, angular blocky; very firm, brittle and compact; thin clay films line pores; very pale brown (10YR 7/3) silt between prisms; few, small, round, dark-brown concretions; very strongly acid; gradual, smooth boundary.

Bx2—25 to 32 inches, brown (7.5YR 4/4) silty clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, very coarse, prismatic structure parting to weak, coarse, angular blocky; very firm, brittle and compact; thin clay films on vertical ped faces; very strongly acid; gradual, smooth boundary.

Bx3—32 to 48 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, medium, distinct, gray (10YR 6/1) mottles; moderate, very coarse, prismatic structure parting to moderate, coarse, angular blocky; firm, brittle and compact; strongly acid; gradual, smooth boundary.

C—48 to 65 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, medium, distinct, gray (10YR 6/1) mottles; massive; firm; common, dark brown, concretionary material; few mica flakes; strongly acid.

Depth to bedrock is more than 10 feet. The solum ranges from 40 to 72 inches in thickness. Depth to the fragipan ranges from 20 to 32 inches. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). The B2t horizon is yellowish brown (10YR 5/4 or 5/6) or brown (7.5YR 4/4) and is mottled with pale brown in the lower part. Mottles have a chroma of 1 or 2 immediately above the fragipan in places. The Bx horizon is brown (10YR 5/3 or 7.5YR 4/4), yellowish brown (10YR 5/4 or 5/6), or dark yellowish brown (10YR 4/4) and is mottled in shades of gray and brown. It ranges from silt loam to silty clay loam. The C horizon is similar in color and texture to the Bx horizon.

Otwell soils are near the somewhat poorly drained Weinbach and McGary soils and the poorly drained Karnak soils. They are similar to the Grenada soils but are subject to flooding and do not have an A'2 horizon.

OtB—Otwell silt loam, 2 to 6 percent slopes. This soil is on long, narrow stream terraces. Areas range from about 15 to 50 acres.

Included with this soil in mapping are a few small areas of Weinbach soils.

This Otwell soil is moderate in natural fertility. It is easy to till. Because it has a fragipan, the root zone is only moderately deep and is saturated in winter and early in spring.

This soil is suited to most crops grown in the county. Corn and soybeans grow well under a high level of management. Some pasture and hay plants that grow well are all the locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is moderate in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover. Floods occur occasionally in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by occasional flooding. Because the soil is near large perennial streams and is very rarely flooded during the season of use, it has potential for picnic areas. Capability unit IIe-1; woodland group 3o1.

Ramsey Series

The Ramsey series consists of steep to very steep, somewhat excessively drained soils that are shallow over bedrock. These soils are on hillsides on uplands. The areas are highly dissected by intermittent drainageways. The soils formed in material weathered from acid sandstone.

In a representative profile the surface layer is brown loam about 3 inches thick. The subsurface layer is pale-brown loam 3 inches thick. The subsoil is friable, yellowish-brown fine sandy loam 12 inches thick. It is channery in the lower part. Fine-grained sandstone bedrock is at a depth of 18 inches.

These soils have a shallow root zone. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is rapid, and the available water capacity is very low. Natural fertility is low.

Most areas are wooded. A few areas have been cleared and are used for pasture or are idle. Crop response is poor to additions of lime and fertilizer.

Representative profile of Ramsey loam in an area of Steinsburg-Ramsey loams, 20 to 30 percent slopes, 750 feet southwest of Peter Howton road, 50 feet southeast of pipeline, 1.1 miles south of Kentucky Highway 70:

A1—0 to 3 inches, brown (10YR 4/3) loam; weak, fine, granular structure; very friable; many roots; very strongly acid; clear, smooth boundary.

A2—3 to 6 inches, pale-brown (10YR 6/3) loam; weak, fine, granular structure; friable; many roots; very strongly acid; clear, smooth boundary.

B21—6 to 14 inches, yellowish-brown (10YR 5/4) fine sandy loam; weak, fine, subangular blocky structure; friable; many roots; few, small, black, soft concretions; 2 percent coarse fragments; very strongly acid; clear, smooth boundary.

B3—14 to 18 inches, yellowish-brown (10YR 5/4) channery fine sandy loam; weak, fine, subangular blocky structure; friable; 35 percent coarse fragments; very strongly acid; abrupt, smooth boundary.

R—18 inches, strong-brown (7.5YR 5/6), soft, fine-grained sandstone; very strongly acid.

Depth to bedrock and solum thickness range from 8 to 20 inches. Reaction is strongly acid or very strongly acid throughout. The A horizon is less acid where limed. Each horizon ranges from 0 to 35 percent coarse fragments.

The soil is loam or fine sandy loam or their channery analogs. The A1 or Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The A2 horizon is pale brown (10YR 6/3), brown (10YR 5/3), or yellowish brown (10YR 5/4). The B horizon is yellowish brown (10YR 5/4 or 5/6) or strong brown (7.5YR 5/6).

Ramsey soils are near the moderately deep Steinsburg and Frondorf soils.

RsF—Ramsey-Steinsburg-Rock outcrop complex, 30 to 50 percent slopes. This mapping unit is about 45 percent Ramsey loam, 35 percent Steinsburg loam, 10 percent Rock outcrop, and about 10 percent other soils.

Included with this unit in mapping are areas of Ramsey and Steinsburg soils that have a surface layer of fine sandy loam or silt loam. Also included are small areas of Frondorf soils and soils that are similar to Steinsburg and Ramsey soils but are underlain by shale or contain more clay in the subsoil.

Practically all areas are wooded. The unit is too steep to be used for cultivated crops or to be cleared and seeded to pasture crops. It is best suited to woodland or as food and cover for wildlife.

All urban uses are severely limited by very steep slopes. Capability unit VIIs-2; woodland group 4d1 (N), 5d1 (S).

Sadler Series

The Sadler series consists of gently sloping, moderately well drained soils that have a fragipan. These soils are on broad ridgetops on uplands. They formed in a thin mantle of loess over material weathered from acid sandstone and shale.

In a representative profile the surface layer is dark grayish-brown silt loam about 7 inches thick. The subsoil is 34 inches thick. The upper 12 inches is friable, yellowish-brown silt loam. The next 5 inches is friable, light-gray silt loam mottled with yellowish brown. The lower 17 inches of the subsoil is a fragipan of firm, light brownish-gray silt loam that is mottled with brown and yellowish brown. The underlying material to a depth of 60 inches is yellowish brown silty clay loam that is mottled with light brownish gray and strong brown.

These soils have a moderately deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. Natural fertility is moderate, and the content of organic matter is low.

Most areas are cleared and used for row crops, pasture, and hay. Crop response is good to additions of lime and fertilizer. Some areas are wooded or are idle.

Representative profile of Sadler silt loam, 2 to 6 percent slopes, 310 yards west of U.S. Highway 62, 1.8 miles northeast of White Plains:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; many roots; medium acid; abrupt, smooth boundary.

B2t—7 to 19 inches, yellowish-brown (10YR 5/6) silt loam; moderate, fine and medium, subangular blocky structure; friable; thin patchy clay films; many roots; few, small, soft, brown concretions; strongly acid; clear, smooth boundary.

A'2&B—19 to 24 inches, light-gray (10YR 7/2) silt loam, which is the A'2 part; common, fine, distinct mottles of yellowish brown (10YR 5/4 and 10YR 5/6), which is the B part; moderate, medium, angular blocky structure; friable; few roots; common, small, soft, brown concretions; strongly acid; clear, smooth boundary.

B'x—24 to 41 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, prominent mottles of yellowish brown (10YR 5/6) and brown (7.5YR 4/4); weak, very coarse, prismatic structure parting to moderate, medium, angular blocky; firm, compact and brittle; few roots and gray silt coatings between prisms; few, small, soft, brown concretions; strongly acid; clear, smooth boundary.

IIC1—41 to 49 inches, yellowish-brown (10YR 5/4) silty clay loam; noticeable increase in sand; many, medium and coarse, distinct mottles of light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6); massive; firm; strongly acid; clear, smooth boundary.

IIC2—49 to 60 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct mottles of light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6); massive; firm; strongly acid.

Depth to bedrock ranges from 5 to more than 8 feet. The solum ranges from 40 to 60 inches in thickness. Reaction is strongly acid to very strongly acid throughout. The Ap horizon is less acid where limed. Depth to the fragipan ranges from 18 to 28 inches.

The Ap horizon is grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), or brown (10YR 4/3 or 5/3). The B2t horizon ranges from brown (7.5YR 5/4) to brownish yellow (10YR 6/6). The A'2 horizon ranges from grayish brown (10YR 5/2) to very pale brown (10YR 7/3) and has few to many mottles in shades of brown. The matrix and mottles in the Bx horizon range from strong brown (7.5YR 5/6) to light gray (10YR 6/1). This horizon is silt loam or silty clay loam. The C horizon is similar in color and texture to the Bx horizon.

Sadler soils are near the well drained to moderately well drained Zanesville soils and the well-drained Wellston soils. They are similar in drainage to Grenada soils but are less than 48 inches to sandstone and shale residuum.

SdB—Sadler silt loam, 2 to 6 percent slopes. This soil is on broad, smooth, slightly convex ridgetops. Areas range from about 5 to 70 acres. Included in mapping are a few small areas of Calloway and Zanesville soils.

Because this Sadler soil has a fragipan, the root zone is only moderately deep and is saturated in winter and early in spring.

This soil is well suited to most crops grown in the county. Corn, soybeans, tobacco, and small grains grow well under a high level of management. Some pasture and hay plants that grow well are all the locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is moderate in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

Use of this soil for septic tank absorption fields is severely limited by the slowly permeable fragipan. Most other urban uses are moderately limited. Capability unit IIe-1; woodland group 3o1.

Steff Series

The Steff series consists of deep, nearly level, moderately well drained soils in valleys of flood plains. These soils formed in acid alluvium that washed mostly from soils derived from loess-capped sandstone and shale.

In a representative profile the surface layer is dark-brown silt loam about 8 inches thick. The subsoil is 16 inches thick. The upper 10 inches is friable, dark yellowish-brown silt loam, and the lower 6 inches is friable, yellowish brown silt loam mottled with light brownish gray and dark grayish brown. The underlying material to a depth of 60 inches is brown silt loam mottled with pale brown and light gray.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is high, and the content of organic matter is low. The water table rises to within 24 inches of the surface during wet periods unless the soils are artificially drained.

Most areas are cleared and used for row crops and hay. Crops respond well to additions of lime and fertilizer. Some areas are wooded or used for pasture.

Representative profile of Steff silt loam, 250 yards northwest of bridge on Kentucky Highway 70 crossing Tradewater River:

Ap—0 to 8 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B21—8 to 18 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, fine, subangular blocky structure; friable; common roots; medium to strongly acid; clear, smooth boundary.

B22—18 to 24 inches, yellowish-brown (10YR 5/4) heavy silt loam; common, fine, distinct mottles of light brownish gray (10YR 6/2) and dark grayish brown (10YR 4/2); weak, fine, subangular blocky and granular structure; friable; common roots; strongly acid; clear, smooth boundary.

C—24 to 60 inches, brown (10YR 5/3) silt loam; many, medium, distinct mottles of pale brown (10YR 6/3) and light gray (10YR 7/2); massive; friable; few, small, soft, round, black concretions; strongly acid.

Depth to bedrock is more than 12 feet. The solum is 24 to 40 inches thick. Reaction is strongly acid or very strongly acid throughout. The Ap horizon is less acid where limed.

The B21 horizon is brown (10YR 4/3), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). The B22 horizon ranges from light brownish gray (10YR 6/2) to yellowish brown (10YR 5/4) and has few to many mottles in shades of gray and brown. Texture of the B horizon is silt loam or silty clay loam. Mottles that have a chroma of 2 or less are at a depth of less than 24 inches. The C horizon is similar in color and texture to the B22 horizon.

Steff soils are near the somewhat poorly drained Stendal soils and the well-drained Cuba soils. They are similar in drainage to Collins soils, but contain more clay.

Sf—Steff silt loam. This nearly level soil is along streams and in narrow valleys. It formed in recent alluvium near upland soils that formed in material weathered from acid sandstone and shale. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Cuba and Stendal soils. Also included are a few areas of soils along Green River that are less acid but are otherwise similar to Steff soils.

This Steff soil is well suited to corn and soybeans and to all the locally grown grasses, lespedeza, and alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Floods occur in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by flooding. Because the soil is near perennial streams that very rarely flood during the season of use, it has potential for picnic areas. Capability unit I-2; woodland group 1w1.

Steinsburg Series

The Steinsburg series consists of steep to very steep, well-drained soils that are moderately deep over bedrock. These soils are on uplands on hillsides that are highly dissected by intermittent drainageways. The soils formed in material weathered from acid sandstone that is interbedded with shale in places.

In a representative profile the surface layer is brown loam about 3 inches thick. The subsoil is friable fine sandy loam 22 inches thick. The upper 8 inches is brown, and the lower 14 inches is yellowish brown. The underlying material is strong-brown channery fine sandy loam 14 inches thick. Fine-grained sandstone bedrock is at a depth of 39 inches.

These soils have a moderately deep root zone. Permeability is moderately rapid, and the available water capacity is moderate. Natural fertility is moderate, and the content of organic matter is low.

Most areas are wooded. A few areas are cleared and are used for pasture or are idle.

Representative profile of Steinsburg loam in an area of Steinsburg-Ramsey loams, 20 to 30 percent slopes, 300 feet east of Niles Row Road, 0.2 mile north of powerlines crossing road, and 2.0 miles west of Charleston:

O1—1 inch to 0, partly decomposed organic matter.

A1—0 to 3 inches, brown (10YR 4/3) loam; weak, fine, granular structure; very friable; many roots; medium acid; abrupt, wavy boundary.

B1—3 to 11 inches, brown (10YR 5/3) fine sandy loam; weak, fine, subangular blocky structure; friable; many roots; 7 percent coarse fragments of soft sandstone; strongly acid; clear, smooth boundary.

B2—11 to 25 inches, yellowish-brown (10YR 5/6) fine sandy loam; weak, fine, subangular blocky structure; friable; many roots; 15 percent coarse fragments of soft sandstone; clear, smooth boundary.

C—25 to 39 inches, strong-brown (7.5YR 5/6) channery fine sandy loam; massive; friable; common roots; 30 percent coarse fragments of soft sandstone; strongly acid; clear, smooth boundary.

R—39 inches, fine-grained sandstone.

Solum thickness and depth to bedrock range from 20 to 40 inches. Reaction ranges from strongly acid to very strongly acid throughout. The A horizon is less acid where limed.

The A horizon ranges from dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4). It is 0 to 5 percent coarse fragments. The B1 horizon is brown (7.5YR 5/4 or 10YR 5/3), strong-brown (7.5YR 5/6), or yellowish-brown (10YR 5/4 or 5/6) loam or fine sandy loam. It is 5 to 20 percent coarse fragments. The B2 horizon is brown (7.5YR 5/4), strong-brown (7.5YR 5/6), or yellowish-brown (10YR 5/4 or 5/6) loam or fine sandy loam. It is 5 to 20 percent coarse fragments. It is similar in color to the B horizon.

The solum of Steinsburg soils is thicker than defined in the range for the series, but this difference does not alter use and behavior of the soils.

Steinsburg soils are near Ramsey, Frondorf, and Lenberg soils. They are deeper to bedrock than Ramsey soils and contain more sand and less clay in the B horizon than Frondorf and Lenberg soils.

SnE—Steinsburg-Ramsey loams, 20 to 30 percent slopes. This mapping unit is about 45 percent Steinsburg loam, 30 percent Ramsey loam, and 25 percent other soils. Both the Steinsburg soil and the Ramsey soil have the profile described as representative of their respective series.

Included with this unit in mapping are areas of Frondorf silt loam, which makes up about 15 percent of the mapped acreage, and small areas of Wellston soils and rock outcrop. Also included are soils that are similar to Steinsburg and

Ramsey soils, but are underlain by shale or contain more clay in the subsoil. Areas of soils that have a surface layer of fine sandy loam or silt loam are included.

Most areas are wooded. A few areas are cleared and used for pasture or are idle. The unit is too steep to be used for cultivated crops. It is best suited to woodland or as food and cover for wildlife. If the unit is used for pasture, grasses that provide a good ground cover, have a long life, and do not need frequent renovation should be used. Tall fescue and lespedeza grow well. Good plant cover is needed to control runoff and reduce erosion.

Urban uses are severely limited by steep slopes. Capability unit VIIe-1; woodland group 2r1 (N), 3r1 (S).

Stendal Series

The Stendal series consists of deep, nearly level, somewhat poorly drained soils in valleys of flood plains. These soils formed in acid alluvium that washed mostly from soils derived from loess-capped sandstone and shale.

In a representative profile the surface layer is brown silt loam about 10 inches thick. The upper 8 inches of the underlying material is friable, brown silt loam mottled with pale brown and light brownish gray. Below this, to a depth of 60 inches it is light-gray silt loam mottled with brown and dark brown.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is high, and the content of organic matter is low. The water table rises to within 12 inches of the surface during periods of heavy rain unless the soils are artificially drained.

Most areas are cleared and used for row crops and hay. Crops respond well to additions of lime and fertilizer. Some areas are used for pasture or are wooded.

Representative profile of Stendal silt loam, 200 yards northeast of bridge on Government Road crossing Tradewater River:

Ap—0 to 10 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; strongly acid to medium acid; abrupt, smooth boundary.

C1—10 to 18 inches, brown (10YR 4/3) heavy silt loam; many, fine, distinct mottles of pale brown (10YR 6/3) and light brownish gray (10YR 6/2); weak, fine, subangular blocky structure; friable; few roots; many, small, soft, round, black concretions; strongly acid; gradual, smooth boundary.

C2g—18 to 60 inches, light-gray (10YR 7/1) heavy silt loam; many, medium and coarse, prominent mottles of brown (10YR 5/3) and dark brown (10YR 4/3); massive; friable; many, small, soft, round, black concretions; strongly acid.

Depth to bedrock is more than 12 feet. Reaction is strongly acid or very strongly acid throughout. The Ap horizon is less acid where limed.

The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The C1 horizon is brown (10YR 4/3 or 5/3), pale brown (10YR 6/3), or very pale brown (10YR 7/3) and has many mottles in shades of gray and brown. The Cg horizon is gray (10YR 5/1 or 6/1), light gray (10YR 7/1 or 7/2), or light brownish gray (10YR 6/2) and is mottled in shades of brown. The C horizon is silt loam or silty clay loam.

Stendal soils are near the poorly drained Bonnie soils and the moderately well drained Steff soils. They are similar in drainage to Belknap soils but contain more clay.

Ss—Stendal silt loam. This nearly level soil is along streams and in narrow valleys. It formed in recent alluvium. Areas in the valleys are near upland soils that formed in material weathered from acid sandstone and shale. Slope is 0 to 2 percent.

Included with this soil in mapping are a few small areas of Bonnie and Steff soils. Also included are a few areas of soils along the Green River that are less acid but are otherwise similar to Stendal soils.

This Stendal soil is well suited only to row crops and pasture and hay plants that withstand wetness. If artificially drained, it is well suited to corn and soybeans as well as to all the locally grown grasses, to lespedeza, and to alsike and red and white clovers. Because erosion is not a hazard, row crops can be grown year after year. Floods occur in winter and early in spring, but seldom during the growing season. Wetness, the main limitation, can be reduced by artificial drainage.

Most urban uses of this soil are severely limited by flooding and wetness. Capability unit IIw-1; woodland group 1w1.

Strip Mine

St—Strip mine consists of a mixture of stones and unconsolidated material. This material was deposited as spoil in the mining of coal from layers 15 to 125 feet below the surface. Most of it comes from between depths of 60 and 80 feet. The material is a mixture of sandstone, shale, siltstone, some limestone, and unconsolidated gravelly and cobbly clay and loam. Slopes are short and range from gently sloping to very steep. They are mainly steep, and in places are nearly 100 percent.

The fine earth fraction ranges from sand to clay, but is mainly silt loam. It ranges from light brownish gray to yellowish brown. The content of coarse fragments in the upper few feet ranges from 10 to 90 percent, but is mainly about 40 percent. Reaction ranges from extremely acid to moderately alkaline, but is mainly extremely acid or very strongly acid. Both extremes can occur within a few feet because the spoil material is from different geologic strata and is randomly placed.

Most areas are planted to trees, mainly pine, locust, and cottonwood. A few areas have been smoothed and limed, are seeded to fescue, and furnish limited pasture.

Strip mine is not suited to cultivated crops or to pasture and hay. The best uses are woodland and wildlife.

Most urban uses are severely limited by slope and irregular topography. Sanitary landfills are a potential use, as are industrial sites in less sloping areas. Capability unit VIIs-1; not assigned to a woodland group.

Waverly Series

The Waverly series consists of deep, nearly level, poorly drained soils in valleys and depressions of flood plains. These soils formed in acid alluvium that washed mostly from soils formed in loess.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsoil is 31 inches thick. It is friable, light-gray silt loam mottled with pale brown. The underlying material to a depth of 60 inches is light brownish-gray silt loam that is mottled with gray.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is moderate, and the content of organic matter is low. During wet periods the water table is at or near the surface unless the soils are artificially drained.

Most areas are wooded. A few areas are cleared and used for row crops, hay, or pasture. Crop response is fair to additions of lime and fertilizer if the soils are drained.

Representative profile of Waverly silt loam, 500 yards west of Bean Cemetery Road, 0.8 mile north of Kentucky Highway 1302:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; few, fine, distinct mottles of light brownish gray (10YR 6/2); weak, fine, granular structure; friable; many roots; few black concretions; medium to strongly acid; abrupt, smooth boundary.

B21g—8 to 26 inches, light-gray (10YR 7/1) silt loam; few, fine, faint mottles of pale brown (10YR 6/3); weak, medium, subangular blocky structure; friable; few fine roots; many small pores; many, small, round, soft, brown concretions and few, small, round, hard, black concretions; strongly acid; clear, wavy boundary.

B22g—26 to 39 inches, light-gray (10YR 7/1) silt loam; common, fine, faint mottles of pale brown (10YR 6/3); weak, medium, subangular blocky structure; friable; few fine roots; many small pores; many, small, soft, round, brown concretions and few, large (4-millimeter), hard, black concretions; strongly acid to very strongly acid; clear, wavy boundary.

Cg—39 to 60 inches, light brownish-gray (10YR 6/2) silt loam; few, fine, faint mottles of gray (10YR 6/1); massive; friable; many, small, soft, brown concretions and many, large (4-millimeter), hard, black, round concretions; very strongly acid.

Depth to bedrock is more than 12 feet. The solum ranges from 24 to 48 inches in thickness. Reaction is strongly or very strongly acid throughout. The Ap horizon is less acid where limed.

The Ap horizon is grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), or brown (10YR 4/3 or 5/3). It has few or common gray mottles. The B horizon is gray (10YR 5/1 or 6/1), light gray (10YR 7/1 or 7/2), or light brownish gray (10YR 6/2). It has few to many brown mottles. The C horizon is similar in color to the B horizon.

Waverly soils are near the somewhat poorly drained Belknap soils and Calloway soils. They do not have a fragipan, and Calloway soils do. They are similar in drainage to Bonnie soils but have less clay in the B horizon.

Wb—Waverly silt loam. This nearly level soil is in slightly concave areas along streams. It formed in recent alluvium. Slope is 0 to 2 percent.

Included with this soil in mapping are small areas of Belknap and Bonnie soils.

Flooding is a severe hazard to row crops in many places. Erosion is not a hazard. Pasture and hay plants can be grown, and tall fescue and alsike and white clovers are suitable. Soybeans and corn can be grown year after year in the same area if it is adequately drained. Many areas lack suitable drainage outlets.

Flooding and wetness severely limit most urban uses of this soil. Capability unit IIIw-1; woodland group 1w2.

Weinbach Series

The Weinbach series consists of nearly level, somewhat poorly drained soils that have a fragipan. These soils are on stream terraces along the Green River and Pond River. They formed in old acid alluvium that washed mostly from soils derived from sandstone, shale, and loess.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsurface layer is 7 inches thick. It is friable, yellowish-brown silt loam mottled with light brownish gray. The subsoil is 38 inches thick. The upper 6 inches is firm, light brownish-gray silt loam mottled with yellowish brown. The lower 32 inches of the subsoil is a fragipan of very firm, light brownish-gray and gray silty clay loam and silty clay that is mottled with yellowish brown. The underlying material to a depth of 71 inches is gray silty clay that is mottled with yellowish brown.

These soils have a moderately deep root zone and are easily tilled. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. Natural fertility is moderate.

About half of the acreage has been cleared and is used for row crops. Crops response is good to additions of lime and fertilizer. Other areas are wooded or are idle.

Representative profile of Weinbach silt loam, 600 feet west of Pond River, 2 miles south of Kentucky Highway 281:

Ap—0 to 8 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; very friable; many fine roots; medium acid; clear, smooth boundary.

A2—8 to 15 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, fine, granular structure; friable; few fine roots; few, small, round, yellowish-brown concretions; strongly acid; gradual, smooth boundary.

B1—15 to 21 inches, light brownish-gray (10YR 6/2) silt loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; few fine roots; many fine pores; strongly acid; gradual, wavy boundary.

Bx1—21 to 30 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, very coarse, prismatic structure parting to moderate, coarse, angular blocky; very firm, compact and brittle; few fine roots in gray silt coating between prisms; few, small, round, brown concretions; strongly acid; gradual, smooth boundary.

Bx2—30 to 42 inches, gray (10YR 6/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, very coarse, prismatic structure parting to moderate, coarse, angular blocky; very firm, brittle and compact; few fine roots between prisms; few small dark-brown concretions; strongly acid; clear, smooth boundary.

IIBx3—42 to 53 inches, gray (10YR 6/1) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, angular blocky structure; very firm and compact; common small black concretions; mildly alkaline; gradual, smooth boundary.

IIC—53 to 71 inches, gray (10YR 6/1) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; few black concretions; mildly alkaline.

Depth to bedrock is more than 10 feet. The solum is 4 to 5 feet thick. Depth to the fragipan ranges from 18 to 30 inches. Reaction of the solum below the Ap horizon is mainly strongly acid or very strongly acid, but in some places it is medium acid to mildly alkaline below a depth of 40 inches.

The Ap horizon is brown (10YR 5/3) or dark grayish brown (10YR 4/2). The A2 horizon is yellowish brown (10YR 5/4), brown (10YR 5/3), and grayish brown (10YR 5/2) and is mottled in shades of gray. The B1 horizon is light brownish gray (10YR 6/2), pale brown (10YR 6/3), grayish brown (10YR 5/2), and brown (10YR 5/3) and has common or many mottles in shades of brown and gray. It is silt loam or silty clay loam. The Bx horizon is light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or gray (10YR 5/1 or 6/1) and has common or many mottles in shades of brown and gray. It is silt loam or silty clay loam. The B3 horizon and C horizon are similar in color to the Bx horizon. The B3 horizon and C horizon are silty clay or silty clay loam and range from strongly acid to mildly alkaline.

Weinbach soils are near Otwell, McGary, and Karnak soils. They are more poorly drained than Otwell soils and have more silt and less clay in the subsoil, and they have a fragipan, which is lacking in

McGary and Karnak soils. They are similar in drainage to Calloway soils, but are subject to flooding and do not have an A'2 horizon.

Wh—Weinbach silt loam. This soil is on long, narrow stream terraces. Areas range from about 15 to 50 acres in size. Slope is 0 to 2 percent. Included in mapping are a few small areas of Otwell soils.

This Weinbach soil has a slowly permeable fragipan at a depth of about 18 to 30 inches. The moderately deep root zone is saturated in winter and remains wet into the early part of the growing season.

This soil is suited to soybeans and to hay and pasture plants that withstand wetness, for example, tall fescue, lespedeza, and alsike and white clover. It is only fairly suited to corn. Tile drainage is not practical, but surface drains reduce wetness in some places. The hazard of erosion is no more than slight. Floods occur occasionally in winter and early in spring, but seldom during the growing season.

Most urban uses of this soil are severely limited by wetness and occasional flooding. Picnic areas and campsites are potential uses because the soil is adjacent to large perennial streams and is very rarely flooded during the season of these uses. Capability unit IIIw-3; woodland group 1w1.

Wellston Series

The Wellston series consists of deep, sloping to moderately steep, well-drained soils on narrow ridgetops and hillsides on uplands. The areas are highly dissected by intermittent drainageways. The soils formed in a thin mantle of loess and in underlying material weathered from sandstone and shale.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The subsoil is 30 inches thick. The upper 11 inches is friable, strong-brown silty clay loam, and the lower 19 inches is firm, yellowish-brown silty clay loam. The underlying material is 21 inches of strong-brown channery loam that is mottled with pale brown and light yellowish brown. Acid sandstone, siltstone, and shale bedrock is at a depth of 58 inches.

These soils have a deep root zone and are easily tilled. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate, and the available water capacity is high. Natural fertility is moderate, and the content of organic matter is low.

About half of the acreage is cleared and used for row crops, hay, and pasture. Crop response is good to additions of lime and fertilizer. The rest of the areas are wooded.

Representative profile of Wellston silt loam, 6 to 12 percent slopes, 100 yards east of Olive Branch Road, 1.6 miles north of junction with Tucker Schoolhouse Road:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; medium acid; abrupt, smooth boundary.

B21t—7 to 18 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, fine, subangular blocky structure; friable; common roots; few, thin, patchy clay films; strongly acid; clear, wavy boundary.

IIB22t—18 to 37 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; thin, continuous clay films; common roots; few dark concretionary stains; common very fine pores; strongly acid; gradual, wavy boundary.

IIC—37 to 58 inches, strong-brown (7.5YR 5/6) channery loam; common, medium, distinct mottles of pale brown (10YR 6/3) and light yellowish brown (10YR 6/4); massive; friable; strongly acid; 25 percent coarse fragments in lower part; clear boundary.

R—58 inches, acid sandstone, siltstone, and shale.

Depth to bedrock ranges from 40 to more than 60 inches. The solum ranges from 30 to 44 inches in thickness. Reaction is strongly or very strongly acid throughout. The Ap horizon is less acid where limed. Coarse fragments in the lower few inches of the Bt horizon and in the C horizon range from 20 to 40 percent.

The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The Bt horizon is yellowish-brown (10YR 5/4 or 5/6) or strong-brown (7.5YR 5/6) silt loam or silty clay loam. The C horizon is similar in color to the B horizon and is mottled in shades of brown and gray in places. It is loam, silt loam, or silty clay loam or their channery analogs.

Wellston soils are near the moderately deep Frondorf and Lenberg soils.

WlC—Wellston silt loam, 6 to 12 percent slopes. This soil is on convex ridgetops and side slopes that are 200 to 500 feet long. Areas range from about 5 to 50 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are a few small areas of severely eroded Wellston soils and small areas of Zanesville soils. Also included are small areas of Wellston soils that have slopes of less than 6 percent.

This soil is suited to most of the crops grown in the county. Corn, soybeans, tobacco, and small grains grow well under a high level of management. Some hay and pasture plants that grow well are all the locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

Use of this soil for sewage lagoons, sanitary landfills, and playgrounds is severely limited by the steep slopes and depth to bedrock. Most other urban uses are moderately limited. Capability unit IIIe-1; woodland group 2o1.

WlD—Wellston silt loam, 12 to 20 percent slopes. This soil is in areas dissected by drainageways. The areas range from about 5 to 50 acres in size. Slopes are about 200 to 800 feet long.

Included with this soil in mapping are a few small areas of severely eroded Wellston soils and small areas of Zanesville and Frondorf soils.

This Wellston soil is suited only to occasional cultivation because the hazard of erosion is very severe. It is better suited to hay and pasture crops than to row crops (fig. 11). All of the locally grown grasses, lespedeza, and alsike and red and white clovers grow well. In cultivated areas, a suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

Most urban uses of this soil are severely limited by the steep slopes. Capability unit IVe-1; woodland group 2o1.

WpC3—Wellston silty clay loam, 6 to 12 percent slopes, severely eroded. This soil is on convex ridgetops and side slopes. The slopes are 200 to 800 feet long and are dissected by drainageways and small gullies. The areas range from about 5 to 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but more than 50 percent of the surface layer has been removed by erosion.

Included with this soil in mapping are a few small areas of uneroded Wellston soils. Also included are small areas of Zanesville and Frondorf soils.

Figure 11.—Good fescue pasture on Wellston silt loam, 12 to 20 percent slopes.

This Wellston soil is suited only to occasional cultivation, because runoff is excessive and further erosion is a risk. It is better suited to pasture and hay crops than to row crops. Tall fescue, lespedeza, and alsike and red and white clovers grow well. The hazard of erosion is very severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

Use of this soil for sewage lagoons, sanitary landfills, and playgrounds is severely limited by the steep slopes and depth to bedrock. Most other urban uses are moderately limited. Capability unit IVe-3; woodland group 3o1.

Zanesville Series

The Zanesville series consists of gently sloping to moderately steep, moderately well drained to well drained soils that have a fragipan. These soils are on narrow ridgetops and hillsides on uplands. The areas are highly dissected by intermittent drainageways. The soils formed in a thin mantle of loess over material weathered from acid sandstone and shale.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The subsoil is 32 inches thick. The upper 18 inches is friable, strong-brown silt loam. The next 6 inches is friable to firm, yellowish-brown silt loam mottled with pale brown. The lower 8 inches of the subsoil is a fragipan of very firm, yellowish-brown silty clay loam that is mottled with gray and strong brown. The underlying material to a depth of 68 inches is yellowish-brown silty clay loam.

These soils have a moderately deep root zone. Unless limed, they are strongly acid to very strongly acid in the surface layer. Permeability is moderate above the fragipan and slow in the pan. The available water capacity is moderate. The content of organic matter is low.

More than half of these areas are cleared and used for row crops, hay, and pasture. Crop response is good to additions of lime and fertilizer. The other areas are wooded or are idle.

Representative profile of Zanesville silt loam, 2 to 6 percent slopes, 150 feet east of Peter Howton Road, 1.2 miles south of Kentucky Highway 70:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many roots; medium acid; abrupt, smooth boundary.

B21t—7 to 25 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; friable; many roots; common clay films; many small pores and root channels; very strongly acid; clear, smooth boundary.

B22t—25 to 31 inches, yellowish-brown (10YR 5/6) heavy silt loam; common, fine, faint mottles of pale brown (10YR 6/3); moderate, medium, subangular blocky structure; friable to firm; many

roots; many pores and old root channels; common clay films; very strongly acid; clear, smooth boundary.

Bxt—31 to 39 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, distinct mottles of gray (10YR 6/1) and strong brown (7.5YR 5/6); weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very firm, compact and brittle; few roots between prisms; common silt and clay coatings separate prisms; very strongly acid; clear, smooth boundary.

IIC—39 to 68 inches, yellowish-brown (10YR 5/6) silty clay loam; common, medium, distinct mottles of light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4); massive; firm; very strongly acid.

Depth to bedrock ranges from 5 to more than 8 feet. The solum is from 36 to 60 inches thick. Reaction is strongly acid or very strongly acid throughout. The Ap horizon is less acid where limed. Depth to the fragipan ranges from 24 to 32 inches.

The Ap horizon is brown (10YR 4/3 or 5/3), dark grayish brown (10YR 4/2), or yellowish brown (10YR 5/4). The Bt horizon is brown (7.5YR 4/4 or 5/4), strong brown (7.5YR 5/6), or yellowish brown (10YR 5/4 or 5/6) and in places has few to common pale-brown mottles in the lower part. It is silt loam or silty clay loam. The Bx horizon is brown (7.5YR 5/4), strong brown (7.5YR 5/6), or yellowish brown (10YR 5/4 or 5/6) and has many mottles in shades of gray. It is silt loam or silty clay loam. The C horizon is similar in color and texture to the Bx horizon.

Zanesville soils are near the well-drained Wellston soils and the moderately well drained Sadler soils. They are similar to the Loring soils but are less than 48 inches deep to sandstone and shale residuum.

ZnB—Zanesville silt loam, 2 to 6 percent slopes. This soil is on slightly convex ridgetops. Areas are winding and range from about 5 to 60 acres in size. The profile of this soil is the one described as representative of the series. Included in mapping are a few small areas of Sadler and Wellston soils.

This Zanesville soil is easy to till. Because it has a fragipan, the root zone is only moderately deep. Natural fertility is moderate.

This soil is well suited to most of the crops grown in the county. Corn, soybeans, tobacco, and small grains grow well under a high level of management. Some pasture and hay plants that grow well are all the locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is moderate in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

The use of this soil for septic tank absorption fields is severely limited by the slowly permeable fragipan. Use for picnic areas and campsites is slightly limited. Most other urban uses are moderately limited. Capability unit IIe-2; woodland group 3o1.

ZnC—Zanesville silt loam, 6 to 12 percent slopes. This soil is on convex ridgetops and side slopes that are 200 to 500 feet long. Areas range from about 5 to 40 acres in size.

Included with this soil in mapping are small areas of severely eroded Zanesville soils and small areas of Loring and Wellston soils. Also included are small areas of Zanesville silt loam, 2 to 6 percent slopes.

This soil is moderate in natural fertility and is easy to till. Because it has a fragipan, the root zone is only moderately deep.

This soil is well suited to most crops grown in the county. Corn, soybeans, tobacco, and small grains grow well under a high level of management. Some hay and pasture plants that grow well are all the locally grown grasses, lespedeza, and alsike and red and white clovers. The hazard of erosion is severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

The use of this soil for septic tank absorption fields is severely limited by the slowly permeable fragipan. Use for sewage lagoons is severely limited by slope. Most other urban uses are moderately limited. Capability unit IIIe-2; woodland group 3o1.

ZnC3—Zanesville silt loam, 6 to 12 percent slopes, severely eroded. This soil is mainly on side slopes that are about 200 to 800 feet long and are dissected by drainageways. Areas range from about 5 to 40 acres in size. The soil has a profile similar to the one described as representative of the series, but more than 50 percent of the surface layer has been removed through erosion.

Included with this soil in mapping are a few small areas of an uneroded Zanesville silt loam and a few small areas of Wellston soils. Also included are a few small areas of Zanesville and Wellston soils that have 12 to 16 percent slopes.

This Zanesville soil is moderately low in natural fertility and is only moderately easy to till. Because there is a fragipan, the root zone is only moderately deep.

This soil is suited to only occasional cultivation, because runoff is excessive and further erosion is a hazard. It is better suited to pasture and hay crops than to row crops. Tall fescue, lespedeza, and alsike and red and white clovers grow well. The hazard of erosion is very severe in cultivated areas. A suitable cropping system and erosion control are needed. Hay and pasture crops must provide a good plant cover.

The use of this soil for septic tank absorption fields is severely limited by the slowly permeable fragipan. Use for sewage lagoons is severely limited by slope. Most other urban uses are moderately limited. Capability unit IVe-4; woodland group 4o1.

ZnD3—Zanesville silt loam, 12 to 20 percent slopes, severely eroded. This soil is on side slopes that are about 200 to 600 feet long and are dissected by drainageways and gullies. Areas range from about 5 to 30 acres in size. The soil has a profile similar to the one described as representative of the series, but more than 50 percent of the surface layer has been removed through erosion.

Included with this soil in mapping are areas of an uneroded Zanesville silt loam and a few small areas of Wellston and Frondorf soils.

This Zanesville soil is moderately low in natural fertility and is only moderately easy to till. Because there is a fragipan, the root zone is only moderately deep.

This soil is not suited to cultivated crops because it is severely eroded and further erosion is a risk. This soil can be used for hay and pasture crops, for example, tall fescue and lespedeza. Hay and pasture crops must provide a good plant cover.

Most urban uses are severely limited by slope. Capability unit VIe-2; woodland group 4o1.

Use and Management of the Soils

This section is a general guide to the management of the soils of Hopkins County. General principles of soil management for crops and pasture are defined on the pages that

follow. The capability system is explained, and the eight classes in the system and the subclasses and units in Hopkins County are described. Estimates of yields of suitable crops are given for each of the soils under high and medium levels of management. The suitability of the soils is described for woodland and for wildlife. There are also sections on use of the soils for engineering and town and country planning.

Crops and Pasture

Some general principles of management apply throughout the county to all soils suitable for farm crops and pasture, although the individual soils or groups of soils require different kinds of management. These general principles of management are described in the following paragraphs.

Most of the soils in Hopkins County are naturally acid and have a moderate or low supply of basic plant nutrients. Response to lime and fertilizer is normally good. The amounts to be applied depend on the type of soil, past cropping history, the crop to be grown, and the level of yield desired. They should be based largely on laboratory analysis of soil samples. Information on collecting samples and testing can be obtained at the local office of the Soil Conservation Service or from the county extension agent.

Most of the soils of Hopkins County were never high in content of organic matter. To build up the content to a high level is not economical. It is, however, important to return organic matter to the soil. This can be done by adding farm manure, by returning plant residue, and by growing sod crops, cover crops, and green-manure crops.

Tillage tends to break down soil structure. It should be kept to the minimum necessary to prepare the seedbed and to control weeds. Maintaining the organic-matter content of the plow layer also helps to protect the structure.

On wet soils such as Belknap silt loam, yields of cultivated crops can be increased by tile drainage or open-ditch drainage. Tile drains are costly to install, but they generally provide better drainage than open ditches. Soils that have a fragipan are difficult to drain; they can usually be drained better by open ditches than by tile. Open-ditch drainage is most effective if the ditches intercept the water as it moves horizontally on top of the fragipan. For drainage by either tile or open ditches, suitable outlets are needed.

All of the gently sloping and steeper soils that are cultivated are subject to erosion. Runoff and erosion occur mainly while a cultivated crop is growing or soon after one has been harvested. On erodible soils such as Loring silt loam, 2 to 6 percent slopes, a suitable cropping system and erosion control are needed. As used here, a suitable cropping system refers to the sequence of crops grown and management that includes minimum tillage, mulch planting, using crop residue, growing cover crops and green-manure crops, and using lime and fertilizer. Other erosion control practices are contour cultivation, terracing, contour stripcropping, diversion of runoff, and using grassed waterways. The effectiveness of a particular combination of these measures differs from one soil to another, but different combinations can be equally effective on the same soil. The local representative of the Soil Conservation Service can assist farm owners and operators in planning an effective combination of practices.

Pasture is effective in controlling erosion on all but a few of the soils that are subject to erosion. A high level of pasture management is needed on some soils to provide enough ground cover to keep the soil from eroding. A high level of pasture management provides for fertilization, control of grazing, selection of pasture mixtures, and other practices that are adequate for maintaining good ground cover and forage for grazing. Grazing is controlled by rotating the livestock from one pasture field to another and providing rest periods for the pasture after each grazing period to allow for regrowth of the plants. Some soils need pasture mixtures that require the least renovation to maintain good ground cover and forage for grazing.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farms. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for trees or for engineering.

In the capability system, the kinds of soils are grouped at three levels: the class, the subclass, and the unit. The broadest grouping, the capability class, is designated by Romans numerals I to VIII. In class I are the soils that have the fewest limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclass indicates major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclasses are indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils are subject to little or no erosion but have other limitations that confine their use largely to pasture, range, or wildlife.

Subclasses are further divided into groups called capability units. These are groups of soils that are so much alike that they are suited to the same crops and pasture plants, require about the same management, and have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIw-4.

The eight classes in the capability system and the subclasses and units in Hopkins County are described in the list that follows. The unit designation is given in the "Guide to Mapping Units."

Class I soils have few limitations that restrict their use (no subclasses).
- Unit I-1. Deep, nearly level, well-drained silt loams on flood plains.
- Unit I-2. Deep, nearly level, moderately well drained silt loams on flood plains.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe soils are subject to moderate erosion unless protected.
  - Unit IIe-1. Deep, gently sloping, moderately well drained silt loams that have a fragipan; on uplands and stream terraces.
  - Unit IIe-2. Deep, gently sloping, moderately well drained to well drained silt loams that have a fragipan; on uplands.
- Subclass IIw soils are moderately limited by excess water.
  - Unit IIw-1. Deep, nearly level, somewhat poorly drained silt loams on flood plains.
  - Unit IIw-2. Deep, nearly level, somewhat poorly drained loams on stream terraces.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Subclass IIIe soils are subject to severe erosion if they are cultivated and not protected.
  - Unit IIIe-1. Deep, sloping, well-drained silt loams on uplands.
  - Unit IIIe-2. Deep, sloping, moderately well drained to well drained silt loams that have a fragipan; on uplands.
  - Unit IIIe-3. Deep, gently sloping, moderately well drained, severely eroded silt loams that have a fragipan; on uplands.
- Subclass IIIw soils are severely limited for cultivation because of excess water.
  - Unit IIIw-1. Deep, nearly level, poorly drained, frequently flooded silt loams; on flood plains.
  - Unit IIIw-2. Deep, nearly level, somewhat poorly drained silt loams that have a clayey subsoil; on stream terraces.
  - Unit IIIw-3. Deep, nearly level, somewhat poorly drained silt loams that have a fragipan; on uplands and stream terraces.
  - Unit IIIw-4. Deep, nearly level, poorly drained silty clays; on flood plains.
  - Unit IIIw-5. Deep, nearly level, poorly drained silt loams that have a clayey subsoil; on flood plains.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Subclass IVe soils are subject to very severe erosion if they are cultivated and not protected.
  - Unit IVe-1. Deep, moderately steep, well-drained silt loams; on uplands.
  - Unit IVe-2. Deep, sloping, moderately well drained to well drained silty clays; on uplands.
  - Unit IVe-3. Deep, sloping, well-drained, severely eroded silty clay loams; on uplands.
  - Unit IVe-4. Deep, sloping, moderately well drained to well drained, severely eroded silt loams and silty clay loams that have a fragipan; on uplands.

Class V (none in Hopkins County) soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.
- Subclass VIe soils are severely limited, chiefly by risk of erosion, unless protective cover is maintained.
  - Unit VIe-1. Moderately deep, moderately steep and steep, well-drained silt loams underlain by sandstone and shale; on uplands.
  - Unit VIe-2. Deep, moderately steep, severely eroded, moderately well drained to well drained silt loams that have a fragipan underlain by sandstone and shale; on uplands.

Class VII soils have very severe limitations that make them unsuitable for cultivation and restrict their use largely to range, woodland, or wildlife food and cover.
- Subclass VIIe soils are very severely limited, chiefly by risk of erosion, unless protective cover is maintained.
  - Unit VIIe-1. Shallow to moderately deep, steep, well drained to somewhat excessively drained loams underlain by sandstone that is interbedded in places with shale; on uplands.
  - Unit VIIe-2. Deep, moderately steep to very steep, moderately well drained to well drained silty clay loams on uplands and deep, nearly level, moderately well drained silt loams on flood plains.
  - Unit VIIe-3. Sloping to steep, very severely eroded land in which most of the soil profile has been destroyed.
- Subclass VIIw soils are very severely limited by excessive water.
  - Unit VIIw-1. Marsh areas that are covered with water most of the year.
- Subclass VIIs soils are very severely limited by low available water capacity, stones, or other soil features.
  - Unit VIIs-1. Gently sloping to very steep, mostly stony spoil material from strip mining.
  - Unit VIIs-2. Shallow to moderately deep, very steep, well drained to somewhat excessively drained loams and rock outcrop underlain by sandstone that is interbedded in places with shale; on uplands.

Class VIII (none in Hopkins County) soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

Estimated yields

Table 2 shows estimates of yields, under two levels of management, of the principal crops grown in Hopkins County. The two levels of management are average and high-level management.

As used in this survey, an average level of management includes the following:

1. Surface and internal drainage is improved, but not enough to provide optimum growing conditions.
2. Moderate amounts of fertilizer and lime are applied, but a more adequate program of soil testing is needed.
3. Most crop residue is returned to the soil. If low-residue crops are grown, organic matter is supplied by growing cover crops and applying manure or other organic material.
4. Seedbed preparation is either inadequate or excessive, and the soil is worked when either too wet or too dry.
5. Weeds and insects are not adequately controlled.
6. Crop variety, seed quality, and plant population are not considered for a specified soil or location.
7. Control of erosion is inadequate.
8. Reseeding of hay and pasture crops is generally delayed until after the legumes have disappeared from the forage stand and the grasses show serious nitrogen deficiency.
9. Grass-legume stands are of medium quality, and crop variety and seed quality or quantity are not considered.
10. Field operations are generally timely.
11. The entire pasture is grazed and is sometimes overgrazed late in summer and in fall.

High-level management includes the following:

1. Surface and internal drainage provide optimum growing conditions.
2. Lime, phosphate, potash, nitrogen, and other elements are applied according to crop needs and the needs indicated by soil tests.
3. All crop residue is returned to the soil. If low-residue crops are grown, organic matter is supplied by growing cover crops and by applying manure or other organic material.
4. Seedbed preparation is limited to that needed for crop production. Tillage is avoided when the soils are wet, and spring tillage is delayed until planting time. If plowed in fall, fields are left rough in winter. Green-manure crops are plowed under no earlier than October 1 of the seeding year.
5. Weeds and insects are adequately controlled.
6. Crop variety, seed quality, and plant population are considered for a specified soil and location.
7. Erosion is kept within tolerated limits.
8. Hay and pasture crops are reseeded and reestablished regularly.
9. Grass-legume stands are of high quality, and crop variety is considered for a specified soil and location.
10. Grazing is deferred and rotated as needed.
11. Field operations are timely for both cultivated and forage crops.

Yields to be expected under an average level of management are shown in column A, and those to be expected under a high level of management are shown in column B. No estimates for an average level of management are given for tobacco, since it is nearly always grown under a high level of management.

Woodland [2]

This section describes the woodland in Hopkins County. It also explains woodland grouping of soils and provides information about the woodland groups in this county.

Originally Hopkins County was covered with forest. In the early 1800's settlers began clearing the upland oak-hickory stands for farming, commercial logging began to flourish, and soon 20 sawmills were operating in the county. As the upland soils became less productive, farmers began to clear, drain, and farm the bottom lands. Over the years, large areas of bottom-land hardwoods in the Tradewater River and Pond River Valleys have been cleared. Today fields of corn and soybeans grow where stands of sweetgum, cherrybark oak, hickory, and swamp white oak once grew. Today most of the woodland is in relatively small tracts on uplands or poorly drained bottoms unsuitable for agriculture.

By 1972 only four major sawmills were still operating in the county, one of which is a stave mill. Three small sawmills do custom sawing, and two post treatment plants provide treated posts for local use. Two pulpwood mills are about 100 miles away near Hawesville, Ky.

Today approximately 45 percent of Hopkins County, or 165,000 acres, remains in woodland. Practically all of this acreage is in private ownership. Lack of management, improper harvesting practices, fire, and grazing have reduced the quality and growth of existing stands. Only one-third of the commerical forest is well stocked with merchantable or potentially merchantable trees.

Several major forest types are in Hopkins County. Oak-hickory forest covers the largest area and consists predominantly of post, southern red, white, black, and scarlet oaks and hickory. Understory species are generally hickory, sugar maple, blackgum, dogwood, red maple, redbud, and sassafras. Ground vegetation consists of redcedar, smilax, wild grape, violet, cinquefoil, blueberry, mayapple, and mullein. This forest type occurs on uplands and ridges in a wide variety of sites. It grows chiefly on Loring, Steinsburg, Ramsey, Wellston, Frondorf, Grenada, and Zanesville soils.

The central mixed hardwood forest consists of yellow-poplar, sugar maple, red maple, beech, black walnut, elm, and northern red oak. Understory species are yellow-poplar, black oak, white oak, dogwood, hickory, ash, and sassafras. Ground vegetation is generally smilax, grasses, dogwood, hickory, redcedar, wild grape, Christmas fern, poison-ivy, and sassafras. This forest type covers a wide

[2] Prepared in collaboration with CHARLES A. FOSTER, staff forester, Soil Conservation Service.

TABLE 2.—*Estimated average*

[Figures in columns A are yields expected under a medium level of management; those in columns B under a high level of management.

Soil	Corn		Wheat		Tobacco
	A	B	A	B	B
	Bu	*Bu*	*Bu*	*Bu*	*Lb*
Belknap silt loam	85	110	30	45	2,200
Bonnie silt loam		85			
Calloway silt loam	60	85		30	1,800
Collins silt loam	85	120	30	45	2,500
Cuba silt loam	90	125	35	50	2,800
Frondorf-Lenberg silt loams, 12 to 30 percent slopes					
Grenada silt loam, 2 to 6 percent slopes	70	95	25	35	2,500
Grenada silt loam, 2 to 6 percent slopes, severely eroded	60	85	20	30	
Karnak silt loam, overwash	85	110	30	45	2,200
Karnak silty clay	50	90	20	30	
Loring silt loam, 2 to 6 percent slopes	80	100	30	40	2,700
Loring silt loam, 6 to 12 percent slopes	70	90	25	35	2,400
Loring silty clay loam, 6 to 12 percent slopes, severely eroded	50	75	20	30	2,000
Markland silty clay, 6 to 12 percent slopes, severely eroded	45	60	15	20	
McGary silt loam	40	60			1,600
McGary loam, loamy subsoil variant	85	110	30	45	2,400
Otwell silt loam, 2 to 6 percent slopes	70	95	25	35	2,000
Sadler silt loam, 2 to 6 percent slopes	70	95	30	40	2,500
Steff silt loam	85	120	30	45	2,500
Steinsburg-Ramsey loams, 20 to 30 percent slopes					
Stendal silt loam	85	110	30	45	2,200
Waverly silt loam		75			
Weinbach silt loam	60	85	25	35	1,800
Wellston silt loam, 6 to 12 percent slopes	80	100	30	40	2,700
Wellston silt loam, 12 to 20 percent slopes	75	95	30	40	1,900
Wellston silty clay loam, 6 to 12 percent slopes, severely eroded	70	90	25	35	2,000
Zanesville silt loam, 2 to 6 percent slopes	75	95	30	40	2,700
Zanesville silt loam, 6 to 12 percent slopes	70	90	30	35	2,400
Zanesville silt loam, 6 to 12 percent slopes, severely eroded	50	75	15	25	2,000
Zanesville silt loam, 12 to 20 percent slopes, severely eroded			15	20	

[1] Pasture is tall fescue and a legume.
[2] Cow-acre-days is a term used to express the carrying capacity of pasture. The number of animal units carried per acre multiplied by the number of

variety of sites but generally is on lower positions of slopes, northerly aspects, in moist coves, and on flats. It grows mainly on Collins, Frondorf, Wellston, Steinsburg, and Ramsey soils.

The elm-ash-cottonwood forest type consists of cottonwood, white ash, green ash, American elm, winged elm, sycamore, red maple, and silver maple. Understory species include hornbean, ash, and elm. Ground cover often consists of cane, pawpaw, coralberry, smilax, poison-ivy, and bog goldenrod. This forest type is along riverbanks and flood plains on well drained to somewhat poorly drained soils. It grows chiefly on Belknap and Calloway soils.

To realize the potential of the woodland in the county, it is necessary to improve the growing stock of desirable tree species and to relate management to features that affect the productivity potential of the soils. Soil properties strongly influence adaptation of tree species, tree growth, and the woodland management required. Differences in soil depth and texture, drainage, available water capacity, and fertility affect the growth of trees. Other features, such as slopes and aspect, account for differences in tree growth.

Woodland grouping

The soils of Hopkins County have been placed in woodland groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need about the same management where the vegetation on them is similar, and that have the same potential production.

Each woodland group is identified by a three-part symbol, such as 1o1, 2w1, or 3w1. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1, very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field determination of average site index. Site index of a given soil is the height, in feet, that the taller trees of a given species reach in a natural, essentially unmanaged stand in a stated number of years, generally 50 years. Site index can be converted into approximate expected growth per acre in board feet. For Hopkins County conversions of average site index into volumetric growth are based on upland oak (*8*); yellow-poplar (*4*); Virginia pine (*5*); and sweetgum and cottonwood (*7*).

The second part of the symbol identifying a woodland group is a small Arabic letter. In this survey *w, d, c, r,* and *o* are used. Priority in placing each kind of soil into a subclass must be in the order that the letters are listed. Except for the *o*, the small Arabic letter indicates an important soil property that imposes a hazard on limitation in manag-

acre yields of principal crops

Absence of a yield figure indicates crop is seldom, if ever, grown on the soil at the specified level of management. Only arable soils are listed]

Soybeans		Hay				Pasture [1]	
		Red clover and grass		Lespedeza			
A	B	A	B	A	B	A	B
Bu	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [2]	*Cow-acre-days* [2]
30	40		3.0	1.8	2.7	180	210
20	30		2.5		1.9	140	170
25	30	1.9	2.8	1.3	1.8	150	170
30	40	2.2	3.2	1.8	2.8	180	240
35	45	2.4	3.4	2.0	2.8	200	250
						120	160
25	35	2.0	3.4	1.7	2.2	170	200
25	30	1.4	2.2	1.5	2.0	150	190
30	40	2.1	3.0	2.0	2.7	180	230
25	35	1.5	2.6	1.4	2.0	150	200
30	35	2.2	3.0	1.8	2.2	180	200
25	30	2.0	2.6	1.5	2.0	170	200
20	30	1.3	2.1		1.5	130	180
20	25	1.0	1.5		1.5	130	160
15	20		1.5	1.0	1.6	130	160
30	40	2.1	3.0	1.5	2.0	180	230
25	30	1.8	2.5	1.5	2.0	170	200
25	35	2.0	3.0	1.2	1.9	170	200
30	40	2.4	3.4	1.8	2.5	180	240
						110	150
30	40		3.0	1.5	2.5	180	230
20	30		2.0		1.7	140	180
25	35	1.9	2.8	1.5	1.8	160	200
30	35	2.1	3.0	1.5	2.2	180	220
30	35	1.7	2.5			170	200
25	30	1.4	2.2		1.8	160	200
30	35	2.2	3.0	1.4	2.2	170	200
25	30	2.0	2.9	1.3	2.2	170	200
20	25	1.2	2.7		1.5	140	170
15	20		1.5			110	150

days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for two cows has a carrying capacity of 60 cow-acre-days.

ing the soils of the group for trees. The letter *w* means excessive wetness, either seasonal or all year. The letter *d* means a restricted root depth. The letter *c* stands for limitations resulting from the kind and amount of clay in the upper part of the soil profile. The letter *r* shows that the main limitation is steep slopes and that there is hazard of erosion and possibly limitations to use of equipment. Unless some other limitation is dominant, *r* is used if slopes are greater than 20 percent. The letter *o* shows that the soils have slight or no limitations that restrict their use for trees.

The last part of the symbol, another number, differentiates woodland groups that have identical first and second parts in their identifying symbol. Soils in woodland group 1w1, for example, require different management or are suited to other species of trees than soils in group 1w2 because they have different soil properties.

In table 3 each woodland group in the county is rated slight, moderate, or severe for various management hazards or limitations. These limitations are described in the following paragraphs.

Erosion hazard refers to the potential hazard of soil losses in well-managed woodland. The hazard is *slight* if expected soil losses are small; *moderate*, if some soil losses are expected and care is needed during logging and construction to reduce soil losses; and *severe* if special methods of operation are necessary for preventing excessive soil losses.

Equipment limitations depend on soil characteristics that restrict or prohibit the use of harvesting equipment, either seasonally or continuously. *Slight* means no restrictions in the kind of equipment or time of year it is used; *moderate* means that use of equipment is restricted for 3 months of the year or less; *severe* means that special equipment is needed and that its use is severely restricted for more than 3 months of the year.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions when plant competition is assumed not to be a factor. *Slight* means a loss of 0 to 25 percent; *moderate* means a loss of 25 to 50 percent; and *severe* means a loss of more than 50 percent of the seedlings. It is assumed that seed supplies are adequate.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. Conifers and hardwoods are rated separately in table 3. *Slight* means that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development;

TABLE 3.—*Wood crops and manage-*

[Gullied land (Gu), Strip mine (St), Mine dump (Mn), Mine wash (Mw), and Bonnie and Karnak soils,

Woodland groups and map symbols	Potential productivity			
	Species	Average site index	Basis	Average annual growth per acre
			No. of plots [1]	*Board feet* [2]
Group 1o1. Nearly level, well-drained loamy soil on flood plains. This soil is subject to flooding. Cu.	Cottonwood Yellow-poplar	95+ 104	([3]) 1	570+ 590
Group 1w1. Nearly level, moderately well drained and somewhat poorly drained loamy soils on flood plains and stream terraces. All but Calloway soils are subject to flooding. Calloway (Cc) and Weinbach (Wh) soils have a fragipan at a depth of about 20 to 30 inches. Bn, Cc, Co, Sf, Ss, Wh.	Cottonwood Yellow-poplar Sweetgum	98 90 100	1 3 2	615 440 550
Group 1w2. Nearly level, poorly drained loamy and clayey soils on flood plains. These soils are subject to flooding. Bo, Kb, Kc, Wb.	Sweetgum Pin oak	95-105 95	([3]) 2	495-600 450
Group 2o1. Sloping and moderately steep, well-drained loamy soils on uplands. These soils formed in loess and in material weathered from sandstone and shale. WIC, WID.	Upland oak Yellow-poplar Virginia pine	75 82-96 63-77	31 16 10	240 350-510 440-560
Group 2r1. Moderately steep and steep, well-drained and somewhat excessively drained, moderately deep and shallow loamy soils on cool, north- and east-facing slopes on uplands. The subsoil is clayey in places. These soils formed in loess and in material weathered from sandstone and shale. FdE, SnE.	Upland oak Yellow-poplar Sweetgum	76 85-95 82	2 ([3]) 1	250 380-495 350
Group 2c1. Nearly level to very steep, well drained to moderately well drained loamy soils on flood plains and stream terraces. The subsoil is clayey in many places. Some areas are subject to flooding. MbC3, ME. [4]	Upland oak Yellow-poplar	79-83 85-95	4 ([3])	280-325
Group 2w1. Nearly level, somewhat poorly drained loamy soil on terraces. The lower part of the subsoil is clayey. This soil is subject to flooding. Mh.	Sweetgum Pin oak	85-95 85-95	([3]) ([3])	380-495 350-450
Group 3o1. Gently sloping and sloping, well drained to moderately well drained, deep and moderately deep loamy soils on uplands. The subsoil is clayey in places. These soils formed in loess and in material weathered from sandstone or shale. Many of the soils have a fragipan. A few are severely eroded. GnB, LoB, LoC, OtB, SdB, WpC3, ZnB, ZnC.	Upland oak Virginia pine	61-75 68	15 4	125-240 475
Group 3r1. Moderately steep and steep, well-drained and somewhat excessively drained, moderately deep and shallow loamy soils on hot, south- and west-facing slopes on uplands. The subsoil is clayey in places. These soils formed in loess and in material weathered from sandstone or shale. FdE, SnE.	Upland oak Virginia pine	65-75 65-75	([3]) ([3])	160-240 450-540
Group 3w1. Nearly level, somewhat poorly drained soil that has a loamy surface layer and a clayey subsoil. It is on slack-water terraces. Mg.	Upland oak	65-69	8	150-190
Group 4o1. Gently sloping to moderately steep, well drained to moderately well drained, loamy, severely eroded soils on uplands. These soils formed in loess and in material weathered from sandstone or shale. They have a fragipan. GnB3, LoC3, ZnC3, ZnD3.	Upland oak Virginia pine	55-65 55-65	([3]) ([3])	90-150 370-450
Group 4d1. Very steep, well-drained and somewhat excessively drained, moderately deep and shallow loamy soil on cool north- and east-facing slopes on uplands. This soil formed in material weathered from sandstone. RsF. [5]	Upland oak	55-65	1	90-150
Group 5d1. Very steep, well drained and somewhat excessively drained, moderately deep and shallow loamy soil on hot, south- and west-facing slopes on uplands. This soil formed in material weathered from sandstone. RsF. [6]	Upland oak	45-55	([3])	50-90

[1] The number of field plots shown in the above table was taken in Land Resource Areas 120 and 1291.
[2] Average yearly growth per acre is according to International ¼-inch rule.
[3] Estimated.

ment by woodland groups

ponded (BP) are not assigned to a woodland group. Material is variable. Onsite examination is needed]

Hazards and limitations			Plant competition		Species preferred—	
Erosion hazard	Equipment limitations	Seedling mortality	Conifers	Hardwoods	In stand	For planting
Slight	Slight	Slight	Severe	Moderate	Black walnut, sweetgum, yellow-poplar, cherrybark oak, ash, cottonwood.	Black walnut, sweetgum, yellow-poplar, cherrybark oak, ash, cottonwood.
Slight	Moderate	Slight	Severe	Severe	Cottonwood, cherrybark oak, sweetgum, yellow-poplar, white ash, sycamore, swamp white oak.	Cherrybark oak, sweetgum, loblolly pine, sycamore, cottonwood, yellow-poplar on moderately well-drained soils.
Slight	Severe	Severe	Severe	Severe	Pin oak, cottonwood, sweetgum, sycamore, red maple, swamp white oak.	Pin oak, sweetgum, sycamore, loblolly pine.
Slight	Slight	Slight	Severe	Moderate	White oak, post oak, yellow-poplar, black oak, sugar maple, black cherry, black walnut.	Yellow-poplar, shortleaf pine, white pine, white ash, loblolly pine, black walnut.
Moderate	Moderate	Slight	Severe	Moderate	Northern red oak, white oak, yellow-poplar, white ash, black oak, sweetgum, buckeye.	White pine, yellow-poplar, shortleaf pine, black walnut, loblolly pine, white ash.
Moderate	Moderate	Slight	Severe	Moderate	Northern red oak, post oak, white ash, yellow-poplar, black oak, hickory.	Northern red oak, white ash, yellow-poplar, white pine, shortleaf pine, loblolly pine.
Slight	Moderate	Slight	Severe	Moderate	Sweetgum, pin oak, sycamore, white ash, yellow-poplar, cottonwood.	Sweetgum, pin oak, sycamore, white ash, yellow-poplar, cottonwood.
Slight	Slight	Slight	Moderate	Slight	White oak, black oak, scarlet oak, yellow-poplar.	Shortleaf pine, Virginia pine, loblolly pine, white pine, yellow-poplar.
Moderate	Moderate	Slight	Moderate	Slight	Black oak, white oak, Virginia pine, scarlet oak, hickory.	Shortleaf pine, Virginia pine, loblolly pine.
Slight	Moderate	Slight	Severe	Moderate	Bur oak, white ash, sycamore, red maple, post oak, sugar maple, hickory.	Pin oak, sycamore, sweetgum, loblolly pine.
Slight	Slight	Moderate	Slight	Slight	White oak, black oak, scarlet oak, Virginia pine, post oak.	Virginia pine, shortleaf pine, loblolly pine.
Moderate	Severe	Moderate	Slight	Slight	Chestnut oak, scarlet oak, black oak, white oak, southern red oak, hickory, yellow-poplar.	Virginia pine, shortleaf pine, loblolly pine.
Moderate	Severe	Severe	Slight	Slight	Chestnut oak, scarlet oak, black oak, white oak, southern red oak, post oak, hickory.	Virginia pine, shortleaf pine, loblolly pine.

[4] Collins part of ME has a very high productivity potential.
[5] Steinsburg part has a high productivity potential.
[6] Steinsburg part has a moderate productivity potential.

moderate means that competition delays natural or artificial establishment and growth rate, but does not prevent the development of fully stocked normal stands; *severe* means that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and maintenance practices, such as burning, spraying, disking, or girdling, are used.

Table 3 also lists suitable species to favor in existing stands and suitable species for planting.

Wildlife

The abundance of a wildlife species depends largely on the amount and distribution of food, shelter, and water. If any of these elements is missing, inadequate, or inaccessible, the species is absent or scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, to the resulting kinds and patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kinds of soils.

Habitat for wildlife normally can be created or improved by planting suitable vegetation, by properly managing the existing plant cover, by fostering the natural establishment of desirable plants, or by using a combination of these measures (*1*).

In table 4 the soils of Hopkins County are rated according to their suitability for seven elements of wildlife habitat and for three kinds of wildlife. These ratings are helpful in the following ways:

1. Planning the broad use of parks, refuges, nature-study areas, and other recreational developments for wildlife.
2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the relative intensity of management needed to produce individual habitat elements.
4. Eliminating sites that would be difficult or not practical to manage for specific kinds of wildlife.
5. Determining suitable areas to acquire for use by wildlife.

TABLE 4.—*Rating of soils for elements of wildlife habitat and kinds of wildlife*

Soil series and mapping units	Elements of wildlife habitat							Kinds of wildlife		
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants [1]	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Belknap: Bn	Fair	Good	Good	Good		Fair	Fair	Good	Good	Fair.
Bonnie:										
Bo	Poor	Fair	Fair	Fair		Good	Good	Fair	Fair	Good.
BP	Very poor	Very poor	Very poor	Very poor		Good	Good	Very poor	Very poor	Good.
For Karnak part of BP, see Karnak series.										
Calloway: Cc	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Collins: Co	Good	Good	Good	Good		Poor	Poor	Good	Good	Poor.
Cuba: Cu	Good	Good	Good	Good		Poor	Very poor	Good	Good	Very poor.
Frondorf: FdE	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
For Lenberg part, see Lenberg series.										
Grenada: GnB, GnB3	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Gullied land: Gu	Very poor	Very poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Karnak:										
Kb	Fair	Fair	Fair	Good		Good	Good	Fair	Good	Good.
Kc	Fair	Fair	Fair	Good		Poor	Good	Fair	Good	Fair.
Karnak part of BP	Very poor	Very poor	Very poor	Very poor		Good	Good	Very poor	Very poor	Good.
Lenberg	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Mapped only with Frondorf soil.										
Loring:										
LoB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
LoC, LoC3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Markland:										
MbC3	Fair	Good	Good	Good	Fair	Very poor	Very poor	Good	Good	Very poor.
ME	Very poor	Poor	Good	Good	Fair	Very poor	Very poor	Poor	Good	Very poor.
For Collins part of ME, see Collins series.										
McGary:										
Mg	Fair	Fair	Good	Good	Poor	Fair	Fair	Fair	Good	Fair.
Mh	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

TABLE 4.—*Rating of soils for elements of wildlife habitat and kinds of wildlife*—Continued

Soil series and mapping units	Elements of wildlife habitat							Kinds of wildlife		
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants [1]	Wetland	Shallow water areas	Openland	Woodland	Wetland
Mine dump: Mn. Properties are too variable to be estimated. Onsite investigation is needed.										
Mine wash: Mw. Properties are too variable to be estimated. Onsite investigation is needed.										
Otwell: OtB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Ramsey: RsF. For Steinsburg part, see Steinsburg series. For Rock outcrop part, see Rock outcrop.	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
Rock outcrop. Mapped only with Ramsey-Steinsburg soils.	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Sadler: SdB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Steff: Sf	Good	Good	Good	Good	----------	Poor	Poor	Good	Good	Poor.
Steinsburg: SnE. For Ramsey part, see Ramsey series.	Very poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Stendal: Ss	Fair	Good	Good	Good	----------	Fair	Fair	Good	Good	Fair.
Strip mine: St	Very poor	Very poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
Waverly: Wb	Poor	Fair	Fair	Fair	----------	Good	Good	Fair	Fair	Good.
Weinbach: Wh	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Wellston:										
WlC, WpC3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
WlD	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Zanesville:										
ZnB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
ZnC, ZnC3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
ZnD3	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.

[1] A dash in the coniferous plants column indicates coniferous plants are not grown on these soils.

The seven kinds of plants and other elements that make up wildlife habitat are as follows:

Grain and seed crops.—These crops include such seed-producing annuals as corn, sorghum, wheat, barley, oats, millet, buckwheat, cowpeas, and other plants commonly grown for grain or for seed. The major soil properties affecting this habitat element are effective root depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer and subsoil.

Domestic grasses and legumes.—In this group are domestic perennial grasses and herbaceous legumes that are established by planting and that furnish wildlife cover and food. Among these plants are bluegrass, fescue, timothy, orchardgrass, reed canarygrass, and clover The major soil properties affecting this habitat element are effective root depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer and subsoil.

Wild herbaceous plants.—In this group are native or introduced perennial grasses and weeds, such as bluestem, quackgrass, panicgrass, goldenrod, wild carrot, nightshade, and dandelion. They provide food and cover mainly for upland forms of wildlife. The major soil properties affecting this habitat element are effective root depth, available water capacity, natural drainage, surface stoniness, hazard of flooding or ponding, and texture of surface layer and subsoil.

Hardwood trees.—This element includes nonconiferous trees, shrubs, and woody vines that produce nuts or other

fruits, buds, catkins, twigs, or foliage that wildlife eat. They are generally established naturally but may be planted. Among the native kinds are oak, cherry, maple, poplar, apple, hawthorn, dogwood, persimmon, sumac, sassafras, hazelnut, black walnut, hickory, sweetgum, bayberry, blueberry, huckleberry, blackhaw, viburnum, grape, and briers. The major soil properties affecting this habitat element are effective root depth, available water capacity, and natural drainage.

Also in this group are several varieties of fruiting shrubs that are raised commercially for planting. Autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crabapple, multiflora rose, and silky cornel dogwood are some of the shrubs that are generally available and can be planted on soils that are rated good. Hardwoods that are not available commercially can commonly be transplanted successfully.

Coniferous plants.—This element consists of cone-bearing evergreen trees and shrubs that are used by wildlife primarily for cover, although they also provide browse and seeds for fruitlike cones. Among them are Norway spruce, Virginia pine, loblolly pine, shortleaf pine, pond pine, Scotch pine, redcedar, and Atlantic white-cedar. Generally the plants are established naturally in areas where cover of weeds and sod is thin but they can also be planted. The major soil properties affecting this habitat element are effective root depth, available water capacity, and natural drainage.

Wetland plants.—Making up this group are wild, herbaceous, annual and perennial plants that grow on moist to wet sites exclusive of submerged or floating aquatics. They produce food and cover extensively used by wetland forms of wildlife. They include smartweed, wild millet, bulrush, sedges, barnyardgrass, pondweed, duckweed, duckmillet, arrow-arum, pickerelweed, water willow, wetland grasses, wildrice, and cattails. The major soil properties affecting this habitat element are natural drainage, surface stoniness, slope, and texture of the surface layer and subsoil.

Shallow water areas.—These are areas of shallow water, generally not exceeding 5 feet in depth, near food and cover for wetland wildlife. They are natural wet areas or those created by dams or levees or by water-control devices in marshes or streams. Examples of such developments are wildlife ponds, muskrat marshes, beaver ponds, waterfowl feeding areas, and wildlife watering developments. The major soil properties affecting this habitat element are depth to bedrock, natural drainage, slope, surface stoniness, and permeability. Natural wet areas that are aquifer fed are rated on the basis of drainage class without regard to permeability. Permeability of the soil would apply only to those nonaquifer areas that have a potential for development, and water is assumed to be available off-site.

The three general kinds of wildlife in the county—openland, woodland, and wetland wildlife—are as follows:

Openland wildlife.—Examples of openland wildlife are quail, pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their home in areas of cropland, pasture, meadow, and lawns and in areas overgrown with grasses, herbs, shrubs, and vines.

Woodland wildlife.—Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrush, vireo, scarlet tanager, gray squirrels, red squirrels, gray fox, white-tailed deer, raccoon, and wild turkey. They obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants.

Wetland wildlife.—Ducks, geese, rails, herons, shore birds, and muskrat are familiar examples of birds and mammals that normally make their home in wet areas, such as ponds, marshes, and swamps.

The ratings for wildlife in table 4 are based on the rating listed for the habitat elements in the first part of the table. For openland wildlife, the rating is based on the ratings shown for grain and seed crops, domestic grasses and legumes, wild herbaceous plants, and either hardwood trees or coniferous plants, whichever is most applicable. The rating for woodland wildlife is based on the ratings listed for domestic grasses and legumes, wild herbaceous plants, and either hardwood trees or coniferous plants, whichever is most applicable. For wetland wildlife, the rating is based on the ratings shown for wetland food and cover plants and shallow water areas.

On soils rated *good*, habitat generally is easily created, improved, or maintained. There are few or no soil limitations, and satisfactory results are assured.

On soils rated *fair*, habitat generally can be created, improved, or maintained, but the soils have moderate limitations. A moderate intensity of management and fairly frequent attention is required to assure satisfactory results.

On soils rated *poor*, habitat generally can be created, improved, or maintained; but soil limitations are rather severe. Habitat management is difficult and expensive, and intensive effort is required. Satisfactory results are questionable.

On soils rated *very poor*, it is impractical to create, improve, or maintain habitat because soil limitations are very severe. Unsatisfactory results are probable.

Not considered in the ratings are present land use, the location of a soil in relation to other soils, and the mobility of wildlife.

Engineering [3]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

[3] ROBERT H. SPENCER, JR., civil engineer, Soil Conservation Service, assisted in preparation of this section.

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 6 and 8, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science that may not be familiar to engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering soil classification

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*3*) used by the SCS engineers, Department of Defense, and others, and the AASHTO system (*2*) adopted by the American Association of State Highway and Transportation Officials.

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 7; the estimated classification, without group index numbers, is given in table 5 for all soils mapped in the survey area.

Soil properties significant to engineering

Several estimated soil properties significant in engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic; and the liquid limit, from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 5, but in table 7 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

TABLE 5.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping the first column of this table. The symbol > means

Soil series and map symbols	Depth to— Bedrock	Depth to— Seasonal high water table	Depth from surface	USDA texture	Classification[1] Unified	Classification[1] AASHTO	Coarse fraction greater than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
Belknap: Bn	>12	½-1½	0-60	Silt loam	CL-ML, ML, or CL	A-4	
*Bonnie: Bo, BP. For Karnak part of BP, see Karnak series.	>12	[2] 0-½	0-60	Silt loam	ML or CL	A-4 or A-6	
Calloway: Cc	>5	½-1½	0-27	Silt loam	ML, CL-ML, or CL	A-4 or A-6	
			27-60	Silty clay loam (fragipan)	ML or CL	A-4, A-5, or A-6	
Collins: Co	>10	1½-3	0-60	Silt loam	ML, CL, or CL-ML	A-4	
Cuba: Cu	>10	[2] > 6	0-60	Silt loam	ML or CL	A-4 or A-6	
*Frondorf: FdE. For Lenberg part, see Lenberg series.	1½-3½	> 6	0-15	Silt loam	ML, CL, or CL-ML	A-4 or A-6	0-5
			15-30	Channery silty clay loam and channery loam.	ML, CL, GM, or GC	A-2, A-4, A-6, or A-7	10-40
			30	Sandstone.			
Grenada: GnB, GnB3	>5	1½-2½	0-8	Silt loam	CL-ML or ML	A-4	
			8-15	Silt loam	CL	A-6	
			15-29	Silt loam	CL-ML or CL	A-4	
			29-60	Silt loam, silty clay loam, (fragipan).	CL	A-6 or A-7	
Gullied land: Gu. Properties too variable to be estimated.							
Karnak: Kb, Kc	>12	[2] 0-½	0-8	Silty clay	MH, CH, or CL	A-7	
			8-60	Silty clay, clay	MH or CH	A-7	
Lenberg. Mapped only with Frondorf soil.	1½-3½	> 6	0-10	Silt loam	CL-ML, CL, ML	A-4	0-15
			10-16	Silty clay loam	CL-ML, CL, ML	A-4 or A-6	0-15
			16-34	Channery silty clay	CL, CH, MH	A-7	10-30
			34	Clay shale.			
Loring: LoB, LoC, LoC3	>5	1½-3	0-12	Silt loam	ML	A-4	
			12-28	Silty clay loam	ML or CL	A-6	
			28-45	Silty clay loam and silt loam (fragipan).	ML or CL	A-6	
			45-60	Silt loam	ML or CL	A-6	
*Markland: MbC3, ME. For Collins part of ME, see Collins series.	> 6	[2] 2-3	0-14	Silty clay	ML or CL	A-6 or A-7	
			14-44	Clay	CH or CL	A-7	
			44-60	Clay	CH	A-7	
McGary: Mg	> 6	1-2	0-6	Silt loam	ML or CL	A-6 or A-7	
			6-43	Silty clay	CL or CH	A-7	
			43-60	Clay	CH	A-7	
McGary variant: Mh	> 6	1-2	0-13	Loam	CL-ML, CL, or ML	A-4	
			13-26	Fine sandy clay loam	CL	A-6	
			26-60	Sandy clay	CL	A-6 or A-7	
Mine dump: Mn. Properties too variable to be estimated.							
Mine wash: Mw. Properties too variable to be estimated.							

significant in engineering

units may have different properties, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in more than, and the symbol < means less than.]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
100	95-100	90-100	85-100	20-30	3-10	0.6-2.0	0.18-0.22	4.5-6.0	Low	High	Moderate to high.
	100	95-100	90-100	27-34	8-12	0.6-2.0	0.18-0.22	4.5-5.5	Low	Moderate	High.
100	95-100	90-100	90-100	25-35	5-15	0.6-2.0	0.20-0.23	5.1-6.5	Low	High	Moderate.
100	95-100	90-100	90-100	25-45	2-20	0.06-0.20	0.09-0.12	5.1-6.0	Low to moderate.	High	Moderate.
	100	95-100	90-100	20-35	3-10	0.6-2.0	0.20-0.24	4.5-6.0	Low	Moderate	Moderate to high.
100	95-100	90-100	75-90	27-34	8-12	0.6-2.0	0.19-0.22	4.5-5.5	Low	Low	High.
90-100	90-100	85-100	75-100	20-40	3-20	0.6-2.0	0.18-0.23	4.5-5.5	Low	Low	High.
55-95	50-95	40-80	30-75	20-45	3-25	0.6-2.0	0.08-0.16	4.5-5.5	Low	Moderate	High.
		100	90-100	27-31	4-6	0.6-2.0	0.20-0.23	4.5-6.5	Low	Moderate	Moderate.
		100	90-100	35-40	13-15	0.6-2.0	0.20-0.23	4.5-5.5	Low to moderate.	Moderate	Moderate
		100	90-100	20-30	5-10	0.6-2.0	0.20-0.23	4.5-5.5	Low	Moderate	Moderate.
		100	90-100	35-42	18-21	0.06-0.20	0.10-0.15	4.5-5.5	Low to moderate.	Moderate	Moderate.
		100	95-100	45-80	23-34	0.06-0.20	0.12-0.14	5.6-6.5	Very high	High	Moderate.
		100	95-100	54-80	23-38	0.06-0.20	0.12-0.14	5.6-6.5	Very high	High	Moderate.
85-100	85-100	70-95	50-75	20-30	[3] NP-10	0.6-2.0	0.12-0.18	4.5-5.5	Low	Low	Moderate to high.
85-100	85-100	80-100	70-95	20-40	3-25	0.6-2.0	0.15-0.22	4.5-5.5	Moderate	Moderate	Moderate to high.
70-90	70-90	65-90	60-85	40-55	20-30	0.06-2.0	0.10-0.17	4.5-5.5	Moderate	High	Moderate to high.
	100	95-100	90-100	30-35	5-10	0.6-2.0	0.20-0.23	4.5-6.5	Low	Moderate	Moderate.
100	95-100	95-100	90-100	30-40	10-20	0.6-2.0	0.15-0.20	4.5-5.5	Low	Moderate	Moderate.
100	95-100	95-100	90-100	30-40	10-16	0.06-0.20	0.10-0.15	4.5-5.5	Low	Moderate	Moderate.
100	95-100	95-100	90-100	30-40	10-16	0.6-2.0	0.10-0.15	4.5-5.5	Low	Moderate	Moderate.
	100	95-100	70-90	32-48	12-24	0.6-2.0	0.17-0.20	5.1-6.5	Low to moderate.	Moderate	Moderate.
	100	95-100	90-100	46-55	25-31	0.06-0.20	0.19-0.21	5.1-6.5	High	High	Moderate.
	100	95-100	90-100	50-60	30-35	0.06-0.20	0.19-0.21	7.4-8.4	High	High	Low.
	100	95-100	70-90	34-48	12-15	0.6-2.0	0.22-0.24	5.1-6.0	Low	Low	Moderate.
	100	95-100	90-100	45-55	25-31	<0.2	0.11-0.13	5.1-6.5	High	High	Low.
	100	95-100	90-100	50-60	30-35	<0.2	0.10-0.12	5.6-7.3	High	High	Low.
	100	85-95	60-95	20-30	NP-10	0.6-2.0	0.15-0.19	4.5-5.5	Low	Low	Moderate to high.
	100	80-95	50-65	20-40	12-20	0.6-2.0	0.12-0.17	4.5-5.5	Low	Moderate	Moderate to high.
	100	80-95	50-65	35-50	12-20	0.6-2.0	0.10-0.15	4.5-5.5	Moderate	High	Moderate to high.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Depth to— Bedrock	Depth to— Seasonal high water table	Depth from surface	USDA texture	Classification[1] Unified	Classification[1] AASHTO	Coarse fraction greater than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
Otwell: OtB	> 10	[2] 1½-3	0-7	Silt loam	CL-ML or ML	A-4	
			7-20	Silty clay loam	ML or CL	A-6	
			20-48	Silty clay loam (fragipan)	CL	A-6	
			48-65	Silty clay loam	ML or CL	A-6	
*Ramsey: RsF For Steinsburg part, see Steinsburg series. Properties of Rock outcrop part too variable to estimate.	½-1½	> 6	0-14	Loam and fine sandy loam	ML, CL, SM, or SC	A-2, A-4, or A-6	0-10
			14-18	Channery fine sandy loam	ML, CL, SM, or SC	A-4 or A-6	0-35
			18	Sandstone.			
Rock outcrop. Mapped only with Ramsey-Steinsburg soils.							
Sadler: SdB	> 5	1½-2½	0-24	Silt loam	CL-ML, CL, or ML	A-4	
			24-41	Silt loam (fragipan)	CL-ML, CL, or ML	A-4	
			41-60	Silty clay loam	ML or CL	A-4 or A-6	
Steff: Sf	> 12	[2] 1½-3	0-60	Silt loam	CL-ML, CL, or ML	A-4	
*Steinsburg: SnE For Ramsey part, see Ramsey series.	1½-3½	> 6	0-3	Loam	CL-ML, CL, ML	A-4, A-6	0-5
			3-25	Fine sandy loam	SM, CL-ML, CL, ML	A-2, A-4, A-6	5-20
			25-39	Channery fine sandy loam	SM, CL-ML, CL, ML	A-2, A-4, A-6	20-40
			39	Sandstone.			
Stendal: Ss	> 12	[2] ½-1½	0-60	Silt loam	ML or CL	A-4 or A-6	
Strip mine: St. Properties too variable to be estimated.							
Waverly: Wb	>12	[2] 0-½	0-60	Silt loam	ML, CL, CL-ML	A-4	
Weinbach: Wh	>10	½-1½	0-21	Silt loam	CL-ML, ML, or CL	A-4, A-6	
			21-42	Silty clay loam (fragipan)	ML or CL	A-4 or A-6	
			42-71	Silty clay	MH, CH, or CL	A-7	
Wellston: WIC, WID, WpC3	3½-5	> 5	0-7	Silt loam	ML or CL	A-4	
			7-37	Silty clay loam	CL or ML	A-4 or A-6	
			37-58	Channery loam	ML, CL, or SC	A-4 or A-6	10-30
			58	Sandstone, siltstone, and shale.			
Zanesville: ZnB, ZnC, ZnC3, ZnD3.	>5	2-3	0-31	Silt loam	ML or CL	A-4, A-6	
			31-39	Silty clay loam (fragipan)	ML or CL	A-6	
			39-68	Silty clay loam	ML or CL	A-4 or A-6	

[1] Estimate based on 100 percent passing the 3-inch sieve. [2] Subject to flooding. [3] NP= Nonplastic.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						Inches per hour	*Inches per inch of soil*	*pH*			
	100	100	90-100	27-31	4-6	0.6-2.0	0.20-0.23	4.5-6.0	Low	Moderate	Moderate.
100	95-100	95-100	90-100	30-40	10-20	0.6-2.0	0.15-0.20	4.5-5.5	Low	Moderate	Moderate.
100	95-100	95-100	90-100	30-40	10-16	0.06-0.20	0.10-0.15	4.5-5.5	Low to moderate.	Moderate	Moderate.
100	95-100	95-100	90-100	30-40	10-20	0.6-2.0	0.10-0.15	4.5-5.5	Low	Moderate	Moderate.
80-100	75-100	60-95	30-75	20-35	12-15	>6.0	0.09-0.12	4.5-5.5	Low	Low	Moderate.
80-100	90-100	70-95	35-75	20-35	12-15	>6.0	0.06-0.10	4.5-5.5	Low	Low	Moderate.
95-100	95-100	85-100	80-100	25-35	2-10	0.6-2.0	0.19-0.23	4.5-6.0	Low	Moderate	High.
95-100	95-100	85-100	80-100	25-35	2-10	0.06-0.2	0.07-0.12	4.5-5.5	Low	Moderate	High.
95-100	95-100	90-100	90-100	30-40	10-20	0.6-2.0	0.07-0.12	4.5-5.5	Low	Moderate	High.
100	95-100	85-100	75-100	NP-35	2-10	0.6-2.0	0.19-0.23	4.5-6.5	Low	Moderate	High.
100	95-100	85-100	60-75	NP-35	NP-15	2.0-6.0	0.15-0.19	4.5-6.0	Low	Low	Moderate.
80-100	80-100	60-100	30-55	NP-35	NP-15	2.0-6.0	0.13-0.18	4.5-5.5	Low	Low	High.
80-100	80-100	60-100	30-55	NP-35	NP-15	2.0-6.0	0.10-0.16	4.5-5.5	Low	Low	High.
	100	90-100	75-100	27-40	6-12	0.6-2.0	0.19-0.23	4.5-6.0	Low	High	High.
	100	90-100	85-95	20-35	5-10	0.6-2.0	0.20-0.22	4.5-6.0	Low	High	Moderate to high.
100	95-100	90-100	90-100	25-35	5-15	0.6-2.0	0.20-0.23	4.5-6.0	Low	High	High.
100	95-100	90-100	90-100	30-40	2-20	0.06-0.20	0.09-0.12	4.5-5.5	Low to moderate.	High	High.
		100	95-100	45-80	25-34	0.06-0.20	0.09-0.12	5.1-7.8	High	High	Moderate.
95-100	90-100	85-100	70-95	26-34	4-10	0.6-2.0	0.18-0.22	4.5-6.0	Low	Moderate	Moderate.
95-100	90-100	85-100	75-95	30-40	10-18	0.6-2.0	0.17-0.21	4.5-5.5	Low	Moderate	High.
75-90	75-90	60-90	40-65	20-35	5-14	0.6-2.0	0.12-0.17	4.5-5.5	Low	Moderate	High.
95-100	95-100	90-100	80-100	25-40	5-20	0.6-2.0	0.18-0.20	4.5-6.0	Low	Moderate	High.
95-100	90-100	90-100	85-100	30-40	11-20	0.06-0.2	0.10-0.15	4.5-5.5	Low	Moderate	High.
95-100	90-100	90-100	85-100	30-40	10-20	0.6-2.0	0.10-0.15	4.5-5.5	Low	Moderate	High.

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping the first column

Soil series and map symbols	Suitability as a source of— Road fill	Suitability as a source of— Topsoil	Soil features affecting— Highway location	Soil features affecting— Farm ponds: Reservoir areas
Belknap: Bn	Fair: fair stability; wetness.	Good	Seasonal high water table at a depth of ½ foot to 1½ feet.	Moderate permeability.
*Bonnie: Bo, BP For Karnak part of BP, see Karnak series.	Poor: poor compaction; wetness.	Poor: wetness	Seasonal high water table within a depth of 6 inches; floods.	Moderate permeability.
Calloway: Cc	Fair: fair stability; wetness.	Good	Fair stability; seasonal high water table at a depth of ½ foot to 1½ feet.	All features favorable.
Collins: Co	Fair: fair stability; fair compaction.	Good	Seasonal high water table at a depth of 1½ to 3 feet; floods.	Moderate permeability.
Cuba: Cu	Fair: fair stability; fair compaction.	Good	Floods	Moderate permeability.
*Frondorf: FdE For Lenberg part, see Lenberg series.	Poor: limited quantity of material.	Fair to a depth of 15 inches; poor if slope is more than 15 percent.	Bedrock at a depth of 20 to 40 inches; moderately steep to steep slopes.	Bedrock at a depth of 20 to 40 inches; moderately steep to steep slopes.
Grenada: GnB, GnB3	Fair: fair stability; fair compaction.	Good	Fair stability; seasonal high water table at a depth of 1½ to 2½ feet.	Moderate permeability below fragipan.
Gullied land: Gu. Properties too variable for interpretation. Onsite investigation needed.				
Karnak: Kb, Kc	Poor: very high shrink-swell potential; wetness; highly plastic.	Poor: clayey subsoil	Very high shrink-swell potential; seasonal high water table within a depth of 6 inches; floods.	Nearly level, seasonal high water table within a depth of 6 inches.
Lenberg Mapped only with Frondorf soil.	Poor: limited quantity of material; moderate shrink-swell potential.	Fair to a depth of 10 inches, poor if slope is more than 15 inches.	Bedrock at a depth of 20 to 40 inches; moderate shrink-swell potential; moderately steep to steep.	Bedrock at a depth of 20 to 40 inches; moderately steep to steep.
Loring: LoB, LoC, LoC3	Fair: fair stability; fair compaction.	Good if slope is 0 to 8 percent, fair if more than 8 percent.	Fair trafficability	Moderate permeability below fragipan.
*Markland: MbC3, ME For Collins part of ME, see Collins series.	Poor: plastic; high shrink-swell potential.	Poor: clayey subsoil; slope is more than 15 percent in some places.	Plastic subsoil; high shrink-swell potential; poor stability.	Moderately steep to very steep in some places.
McGary: Mg	Poor: plastic; high shrink-swell potential; wetness.	Poor: clayey subsoil	Plastic subsoil; high shrink-swell potential.	Nearly level; seasonal high water table at a depth of 1 foot to 2 feet.
McGary, variant: Mh	Fair: wetness; moderate shrink-swell potential below a depth of 2 feet.	Good	Seasonal high water table at a depth of 1 foot to 2 feet.	Nearly level; seasonal high water table at a depth of 1 foot to 2 feet.

interpretations

units may have different properties, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in of this table]

Soil features affecting—*Continued*					
Farm ponds—*Continued*: Embankments	Agricultural drainage	Irrigation	Diversions	Grassed waterways	Foundations for low buildings
Susceptible to piping; moderate permeability; erodes easily.	Seasonal high water table at a depth of ½ foot to 1½ feet.	Somewhat poorly drained; floods.	Seasonal high water table at a depth of ½ foot to 1½ feet.	Somewhat poorly drained.	Seasonal high water table at a depth of ½ foot to 1½ feet; floods.
Susceptible to piping; low strength.	Seasonal high water table within a depth of 6 inches; floods.	Poorly drained; floods.	Seasonal high water table within a depth of 6 inches.	Poorly drained	Seasonal high water table within a depth of 6 inches.
Susceptible to piping; fair stability.	Fragipan at a depth of 20 to 30 inches.	Permeability slow in fragipan; somewhat poorly drained.	Seasonal high water table at a depth of ½ foot to 1½ feet; fragipan at a depth of 20 to 30 inches.	Somewhat poorly drained; fragipan at a depth of 20 to 30 inches.	Seasonal high water table at a depth of ½ foot to 1½ feet; fragipan at a depth of 20 to 30 inches.
Susceptible to piping; fair stability.	Seasonal high water table at a depth of 1½ to 3 feet; floods.	Seasonal high water table at a depth of 1½ to 3 feet; floods.	Seasonal high water table at a depth of 1½ to 3 feet; fair stability.	All features favorable.	Seasonal high water table at a depth of 1½ to 3 feet; floods.
Susceptible to piping; fair stability.	Well drained	Floods	Fair stability	All features favorable.	Floods.
Limited borrow material; bedrock at a depth of 20 to 40 inches.	Well drained	Moderately steep to steep slopes.	Moderately steep to steep slopes; bedrock at a depth of 20 to 40 inches.	Moderately steep to steep slopes; bedrock at a depth of 20 to 40 inches.	Bedrock at a depth of 20 to 40 inches; moderately steep to steep slopes.
Fair stability; susceptible to piping.	Fragipan at a depth of 20 to 32 inches.	Permeability slow in fragipan; seasonal high water table at a depth of 1½ to 2½ feet.	Fragipan at a depth of 20 to 32 inches.	Seasonal high water table at a depth of 1½ to 2½ feet; fragipan at a depth of 20 to 32 inches.	Seasonal high water table at a depth of 1½ to 2½ feet; fragipan at a depth of 20 to 32 inches.
Very high shrink-swell potential; compressible.	Floods; seasonal high water table within a depth of 6 inches.	Slow permeability; poorly drained.	Seasonal high water table within a depth of 6 inches; plastic.	Nearly level	Very high shrink-swell potential; floods; seasonal high water table within a depth of 6 inches.
Limited borrow material; bedrock at a depth of 20 to 40 inches.	Well drained	Moderately steep to steep.	Moderately steep to steep; bedrock at a depth of 20 to 40 inches.	Moderately steep to steep; bedrock at a depth of 20 to 40 inches.	Bedrock at a depth of 20 to 40 inches; moderately steep to steep; moderate shrink-swell potential.
Fair stability; susceptible to piping.	Fragipan at a depth of 24 to 35 inches.	Permeability slow in fragipan; seasonal high water table at depth of 1½ to 3 feet.	Fragipan at a depth of 24 to 35 inches.	Seasonal high water table at a depth of 1½ to 3 feet; fragipan at a depth of 24 to 35 inches.	Seasonal high water table at a depth of 1½ to 3 feet; fragipan at a depth of 24 to 35 inches.
High shrink-swell potential; poor stability and compaction.	Well drained to moderately well drained.	Permeability slow in subsoil; slope is more than 12 percent in some places.	Clayey subsoil; moderately steep to very steep in some places.	Clayey subsoil; moderately steep to very steep in some places.	Clayey; high shrink-swell potential; moderately steep to very steep in some places.
High shrink-swell potential; poor stability and compaction.	Seasonal high water table at a depth of 1 foot to 2 feet; slow or very slow permeability; clayey texture.	Somewhat poorly drained; slow or very slow permeability; clayey subsoil.	Clayey subsoil	Clayey subsoil	Seasonal high water table at a depth of 1 foot to 2 feet; clayey; high shrink-swell potential.
Moderate shrink-swell potential below a depth of 2 feet.	Seasonal high water table at a depth of 1 foot to 2 feet.	Somewhat poorly drained.	Somewhat poorly drained.	Somewhat poorly drained.	Seasonal high water table at a depth of 1 foot to 2 feet; moderate shrink-swell potential below a depth of 2 feet.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—	
	Road fill	Topsoil	Highway location	Farm ponds: Reservoir areas
Mine dump: Mn. Properties too variable for interpretation. Onsite investigation needed.				
Mine wash: Mw. Properties too variable for interpretation. Onsite investigation needed.				
Otwell: OtB	Fair: fair stability; fair compaction.	Good	Fair stability; seasonal high water table at a depth of 1½ to 3 feet; floods.	Moderate permeability below fragipan.
*Ramsey: RsF. For Steinsburg part, see Steinsburg series. No interpretations for Rock outcrop part.	Poor: limited quantity of material; bedrock at a depth of 8 to 20 inches.	Poor: bedrock at a depth of 8 to 20 inches; steep to very steep.	Bedrock at a depth of 8 to 20 inches.	Rapid permeability; bedrock at a depth of 8 to 20 inches.
Rock outcrop. Mapped only with Ramsey-Steinsburg soils. Too variable to estimate.				
Sadler: SdB	Fair: fair stability; fair compaction.	Good	Fair stability; seasonal high water table at a depth of 1½ to 2½ feet.	Moderate permeability below fragipan.
Steff: Sf	Fair: fair stability; fair compaction.	Good	Seasonal high water table at a depth of 1½ to 3 feet; floods.	Moderate permeability; nearly level.
*Steinsburg: SnE. For Ramsey part, see Ramsey series.	Poor: limited quantity of material.	Poor: steep to very steep.	Steep to very steep; bedrock at a depth of 20 to 40 inches.	Moderately rapid permeability; steep to very steep; bedrock at a depth of 20 to 40 inches.
Stendal: Ss	Fair: fair stability; wetness.	Good	Seasonal high water table at a depth of ½ foot to 1½ feet; floods.	Moderate permeability.
Strip mine: St. Properties too variable for interpretations. Onsite investigation needed.				
Waverly: Wb	Poor: poor compaction; wetness.	Poor: wetness	Seasonal high water table within a depth of 6 inches.	Moderate permeability.
Weinbach: Wh	Fair: fair stability; wetness.	Good	Fair stability; seasonal high water table at a depth of ½ foot to 1½ feet.	All features favorable.
Wellston: WlC, WlD, WpC3	Fair: fair stability; fair compaction.	Good if slope is 0 to 8 percent; fair if 8 to 15 percent; poor if more than 15 percent.	Moderately steep in some places; other features favorable.	Moderate permeability; moderately steep in some places; bedrock at a depth of 40 to 60 inches.
Zanesville: ZnB, ZnC, ZnC3, ZnD3	Fair: fair stability; fair compaction.	Good if slope is 0 to 8 percent; fair if 8 to 15 percent; poor if slope is more than 15 percent.	Moderately steep in some places.	Moderate permeability below fragipan; moderately steep in some places.

interpretations—Continued

Soil features affecting—*Continued*					
Farm ponds—*Continued*: Embankments	Agricultural drainage	Irrigation	Diversions	Grassed waterways	Foundations for low buildings
Fair stability; susceptible to piping.	Fragipan at a depth of 20 to 32 inches; floods.	Permeability slow in fragipan; seasonal high water table at a depth of 1½ to 3 feet; floods.	Fragipan at a depth of 20 to 32 inches.	Seasonal high water table at a depth of 1½ to 3 feet; fragipan at a depth of 20 to 32 inches.	Seasonal high water table at a depth of 1½ to 3 feet; fragipan at a depth of 20 to 32 inches; floods.
Limited borrow material; bedrock at a depth of 8 to 20 inches.	Somewhat excessively drained.	Steep to very steep; very low available water capacity.	Steep to very steep; bedrock at a depth of 8 to 20 inches.	Steep to very steep; bedrock at a depth of 8 to 20 inches.	Bedrock at a depth of 8 to 20 inches; steep to very steep.
Fair stability; susceptible to piping.	Fragipan at a depth of 18 to 28 inches.	Permeability slow in fragipan; seasonal high water table at depth of 1½ to 2½ feet.	Fragipan at a depth of 18 to 28 inches.	Seasonal high water table at a depth of 1½ to 2½ feet; fragipan at a depth of 18 to 28 inches.	Seasonal high water table at a depth of 1½ to 2½ feet; fragipan at a depth of 18 to 28 inches.
Susceptible to piping; fair stability.	Seasonal high water table at a depth of 1½ to 3 feet; floods.	Seasonal high water table at a depth of 1½ to 3 feet; floods.	Fair stability; seasonal high water table at a depth of 1½ to 3 feet.	All features favorable.	Floods; seasonal high water table at a depth of 1½ to 3 feet.
Limited borrow material; bedrock at a depth of 20 to 40 inches.	Well drained	Steep to very steep	Steep to very steep; bedrock at a depth of 20 to 40 inches.	Steep to very steep; bedrock at a depth of 20 to 40 inches.	Bedrock at a depth of 20 to 40 inches; steep to very steep.
Susceptible to piping; fair stability and compaction.	Floods; seasonal high water table at a depth of ½ foot to 1½ feet.	Somewhat poorly drained; floods.	Seasonal high water table at a depth of ½ foot to 1½ feet; fair stability.	Somewhat poorly drained.	Seasonal high water table at a depth of ½ foot to 1½ feet; floods.
Susceptible to piping; fair stability.	Floods; seasonal high water table within a depth of 6 inches.	Poorly drained; floods.	Seasonal high water table within a depth of 6 inches.	Poorly drained	Floods; seasonal high water table within a depth of 6 inches.
Susceptible to piping; fair stability.	Fragipan at a depth of 18 to 30 inches; floods.	Permeability slow in fragipan; somewhat poorly drained; floods.	Seasonal high water table at a depth of ½ foot to 1½ feet; fragipan at a depth of 18 to 30 inches.	Somewhat poorly drained; fragipan at a depth of 18 to 30 inches.	Seasonal high water table at a depth of ½ foot to 1½ feet.
Susceptible to piping; fair stability and compaction; bedrock at a depth of 40 to 60 inches.	Well drained	Moderately steep in some places.	Moderately steep in some places; bedrock at a depth of 40 to 60 inches.	Moderately steep in some places.	Moderately steep in some places; bedrock at a depth of 40 to 60 inches.
Susceptible to piping; fair stability and compaction.	Fragipan at a depth of 24 to 32 inches.	Fragipan at a depth of 24 to 32 inches; moderately steep in some places.	Fragipan at a depth of 24 to 32 inches; moderately steep in some places.	Moderately steep in some places; fragipan at a depth of 24 to 32 inches; seasonal high water table at a depth of 2 to 3 feet.	Seasonal high water table at a depth of 2 to 3 feet; moderately steep in some places.

TABLE 7.—*Engineering*

[Tests made by Kentucky Department of Highways Research Laboratory, Lexington, in cooperation with the Bureau of Public Roads,

Soil name and location of sample	Parent material	Depth from surface	Moisture-density data [1]		California bearing ratio		Mechanical analysis [2] — Percent passing sieve—	
			Maximum dry density	Optimum moisture	Unsoaked	Soaked	No. 4 (4.7 mm)	No. 10 (2.0 mm)
		In	*Lb per cu ft*	*Pct*				
Belknap silt loam: 100 feet south of gas well, 600 feet east of Kentucky Highway 281, 0.8 mile northwest of U.S. Highway 41. (Modal)	Silty alluvium	9-28	103	18	35	7		100
		28-54	107	18	44	23	100	98
Calloway silt loam: 50 feet west of Kentucky Highway 892, 0.8 mile west of Anton, and 420 feet north of L&N Railroad. (Modal)	Silty loess	9-27	105	18	29	13		100
		27-36	106	17	28	8	100	97
		36-56	104	20	20	4		
		56-65	109	18	17	7	100	98
Karnak silty clay: 200 yards south of barn, located on south side of Kentucky Highway 281, 1¾ miles northeast of Vandetta. (Modal)	Clayey sediment	6-54	97	19	35	3		
		54-68	103	20	18	2		
Steinsburg loam: 1¾ miles west of Beulah on Kentucky Highway 70, turn south on blacktop road for 1.1 miles, then west on gravel road 0.4 mile. Site 200 feet north of road. (Modal)	Sandstone	18-35	120	12	23	11	[4] 100	97
Zanesville silt loam: 1.6 miles west of Beulah on Kentucky Highway 70, go south on gravel road. Site 150 feet east of gravel road. (Modal)	Loess for upper 39 inches; sandstone and shale for the rest.	7-25	107	20	15	15		
		31-39	101	18	40	4		
		39-68	109	15	24	3		100

[1] Based on AASHTO Designation: T 99-57 (*2*).

[2] Mechanical analysis according to AASHTO Designation: T 88-57 (*2*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosion, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Ratings of soils for risk of corrosion to concrete are based

test data

in accordance with standard procedures of the American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analysis [2]						Liquid limit	Plasticity index	Specific gravity	Classification	
Percent passing sieve—Continued		Percent smaller than—							AASHTO [3]	Unified
No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm					
						Pct				
99	96	84	62	19	13	29	5	2.60	A-4(8)	CL-ML
95	89	74	67	23	13	27	6	2.65	A-4(8)	CL-ML
97	93	81	58	28	21	29	6	2.67	A-4(8)	CL-ML
94	91	90	72	36	34	29	2	2.68	A-4(8)	ML
100	97	88	67	30	26	42	8	2.71	A-5(8)	ML
94	91	72	54	30	22	38	16	2.69	A-6(10)	CL
100	98	75	71	59	48	54	23	2.71	A-7-6(16)	MH-CH
100	97	91	81	64	51	67	33	2.72	A-7-6(20)	MH-CH
97	44	41	31	18	14	[5] NP	NP	2.67	A-4(0)	SM
------------	98	93	72	34	25	34	10	2.63	A-4(8)	CL-ML
100	95	87	66	36	29	40	16	2.71	A-6(10)	CL-ML
99	89	81	53	29	22	30	10	2.60	A-4(8)	CL-ML

calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[3] Based on AASHTO Designation M 145-49 (*2*).

[4] About 15 percent fragments larger than 3 inches were discarded in the field and not included in the test data.

[5] NP= Nonplastic.

mainly on soil texture and acidity. Installations that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. Risk of corrosion rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Hopkins County. In table 6, ratings are used to summarize the suitability of the soils as a source of road fill and topsoil. For all other listed uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate

drainage and the relative ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that results at the area from which topsoil is taken.

Soil properties that most affect highway location are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to permeability and depth to fractured or permeable bedrock or other permeable material.

Pond embankments require soil material that is resistant to seepage and piping and that has favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Agricultural drainage is affected by such soil properties as permeability, texture, and structure; depth to fragipan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Diversions are embankments, or ridges, constructed across the slope to intercept runoff and seepage so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for diversions are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material; presence of stones or rock outcrops; and the steepness of slopes. Other factors affecting grassed waterways are seepage, natural drainage, available water capacity, susceptibility to siltation, and the ease of establishing and maintaining vegetation.

Foundations for low buildings are affected chiefly by features of the undisturbed soil that influence the capacity to support low buildings having normal foundation loads. Specific values of bearing strength are not assigned.

Engineering test data

Table 7 contains the results of engineering tests performed by the Kentucky Department of Highways on some of the major soil series in Hopkins County. The table shows the specific location where the samples were taken, the type of parent material in which the soils formed, the depths at which sampling was done, the results of tests to determine particle size distribution, and other properties significant to soil engineering.

Columns in table 7 that are not self-explanatory are described in the following paragraphs.

Moisture-density data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

California Bearing Ratio is the result of a laboratory test to evaluate the bearing value of soil materials. The bearing value of a sample is determined in relation to a "standard" well-graded crushed stone (*6*).

Tests to determine liquid limit and plasticity index measure the effect of water on the consistency of soil material as has been explained for table 5.

Specific gravity is the ratio of the mass of a given volume of soil to that of the same volume of water.

Classification of soils by the AASHTO and Unified classification systems has been discussed earlier in this section under the heading "Engineering soil classification."

Town and Country Planning

This section of the soil survey provides information on the effect of soil properties on selected nonfarm uses. It helps community planners, developers, and individual land owners determine the most suitable use for a particular area. Other useful information can be found on the soil maps and in other parts of the survey, particularly the section Descriptions of the Soils and the section Engineering. Although the soil maps and tables serve as a guide and can eliminate some sites from further consideration, they do not supplant direct detailed onsite investigations when a development is being planned. Not considered in this section are location in relation to established business centers or transportation lines and other economic factors that are important and often determine the ultimate use of an area.

Table 8 gives the estimated degree and kinds of limitations for some selected soil uses. These limitations are rated *slight*, *moderate*, or *severe*. If the rating is *moderate* or *severe*, the main limiting property or properties are given. The ratings are based on the degree of the greatest single limitation. For example, if flooding severely limits the use of a soil in the disposal of sewage effluent from

septic tanks, the limitation is rated *severe*, though the soil is well suited to that use in all other respects. A rating of *slight* indicates that the soil has properties favorable for the rated use. Soil limitations are minor and can be easily overcome. Good performance and low maintenance can be expected on the soil. A rating of *moderate* indicates that the soil has properties moderately favorable for the rated use. The limitations can be overcome or modified with special planning, design, or maintenance. During some seasons of the year the performance of the structure or other planned use is somewhat less desirable than for soils with a slight limitation. A rating of *severe* indicates that the soil has one or more unfavorable properties for the rated use. Limitations are difficult and costly to modify or overcome, requiring major soil reclamation, special design, or intense maintenance. Some soils rated *severe* can be improved by reducing or removing the soil feature that limits its use. In most situations it is difficult and costly to alter the soil or design a structure to compensate for soil limitations that are severe.

The following paragraphs describe the properties considered in rating the soils for each of the uses given in table 8.

Shallow excavations are less than 6 feet deep and are made for a variety of purposes, such as basements, ditches, graves, underground cables, pipelines, and sewers. Among the features that affect shallow excavations are soil drainage class, seasonal water table, flooding, slope, texture, depth to bedrock, stoniness, and rockiness.

Buildings of three stories or less are dwellings no more than three stories high that have no more than 8-foot excavations for basements. Excluded are other buildings with foundation loads in excess of those equal to three-story dwellings. Considered in rating the soils are the depth to a high water table, shrink-swell potential, the depth to and the kind of bedrock, texture, slope, potential frost action, the hazard of flooding, and the need for land shaping and other kinds of landscaping. Flooding is a severe hazard if a soil is used as a homesite. Depth to rock, depth to a seasonal high water table, and natural drainage are less severe limitations for buildings that do not have a basement than for those that do. Methods of sewage disposal are not considered in the ratings.

Local roads and streets pertain to construction and maintenance of improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete. They are expected to carry automobile traffic all year, but not fast-moving, heavy trucks. Properties that affect design and construction of roads and streets are those that affect the load-supporting capacity and stability of the subgrade and those that affect the workability and amount of cut and fill. The AASHTO and Unified classifications of the soil material and the shrink-swell potential give an indication of the traffic-supporting capacity. Wetness and flooding affect stability. Slope, depth to hardrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill needed to reach an even grade. Soil limitation ratings in table 8 do not substitute for basic soil data or for onsite investigations.

Septic tank absorption fields are used year round for this purpose. The main soil limitations for this use are restricted permeability, steepness of slope, insufficient depth to bedrock, a seasonal high water table, and flooding. Limitations of soils for use as disposal fields for summer camps or for other part-time uses may be less severe than indicated in the table.

Sewage lagoons are affected by many of the same limitations as pond reservoir areas, given in table 6. Among the limitations are flooding, seepage, organic-matter content, permeability of the substratum, depth to rock, depth to water table, and slope.

Sanitary landfill is an engineering method of disposing of solid waste on or in the soil by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with soil each day in a manner which provides for maximum protection of the environment. The data in table 8 are valuable in selecting potential alternate sites for a proposed trench type sanitary landfill. They are not a substitute for detailed geologic investigations, because soil borings are normally limited to a depth of 5 or 6 feet. They are especially useful in preliminary determinations of those sites that are not well suited to trench type sanitary landfills, because they save the time and expense of more detailed investigation. They can also indicate sites where additional investigations appear warranted.

The soil properties affecting trench-type sanitary landfills are depth to seasonal high water table, drainage, flooding, permeability, slope, texture, stoniness, rockiness, and depth to and kind of underlying bedrock. Because many landfill operations used trenches as deep as 15 or more feet, there is need for a geological investigation of the area to determine the potential for pollution of ground water as well as to obtain the design of the sanitary landfill.

For lawns and landscaping it is assumed that enough lime and fertilizer are used for growing lawn grasses and ornamental plants. These materials, therefore, are not considered in the ratings. Suitable soil material is needed in sufficient amounts so that desirable trees and other plants can survive and grow well. Among the important soil properties that determine whether a good lawn can be established are depth of the soil, texture, slope, droughtiness, depth to the water table, and the presence of stones or rocks.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry.

Picnic areas are attractive natural or landscaped tracts used chiefly for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry; are free of flooding during the period of use; and do not have slopes or stones that greatly increase the cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soil suitable for this use needs to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse

TABLE 8.—*Limitations to be considered*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil referring to other series that

Soil series and map symbols	Shallow excavations	Buildings of three stories or less	Local roads and streets	Septic tank absorption fields	Sewage lagoons
Belknap: Bn	Severe: floods; somewhat poorly drained.	Severe: floods; somewhat poorly drained.	Severe: floods	Severe: floods; somewhat poorly drained.	Severe: floods
*Bonnie: Bo, BP. For Karnak part of BP, see Karnak series.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods
Calloway: Cc	Severe: somewhat poorly drained.	Severe: somewhat poorly drained.	Moderate: some- poorly drained.	Severe: somewhat poorly drained; slow permeability in fragipan.	Slight
Collins: Co	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
Cuba: Cu	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
*Frondorf: FdE. For Lenberg part, see Lenberg series.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches; slopes are 12 to 30 percent.
Grenada: GnB, GnB3	Moderate: moderately well drained.	Moderate: moderately well drained.	Moderate: ML or CL material.	Severe: slow permeability in fragipan.	Moderate: slopes are 2 to 6 percent.
Gullied land: Gu. No data. Material too variable.					
Karnak: Kb, Kc	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; very high shrink-swell potential; poorly drained.	Severe: floods; poorly drained.	Severe: floods
Lenberg. Mapped only with Frondorf soil.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent; bedrock at a depth of 20 to 40 inches.
Loring:					
LoB	Moderate: moderately well drained.	Moderate: moderately well drained.	Moderate: ML or CL material.	Severe: slow permeability in fragipan.	Moderate: slopes are 2 to 6 percent.
LoC, LoC3	Moderate: moderately well drained; slopes are 6 to 12 percent.	Moderate: moderately well drained; slopes are 6 to 12. percent.	Moderate: ML or CL material; slopes are 6 to 12 percent.	Severe: slow permeability in fragipan.	Severe: slopes are 6 to 12 percent.
*Markland:					
MbC3	Moderate: moderately well drained to well drained; slopes are 6 to 12 percent.	Severe: high shrink-swell potential.	Severe: CH material; high shrink-swell potential.	Severe: slow permeability.	Severe: slopes are 6 to 12 percent.
ME. For Collins part, see Collins series.	Severe: slopes are 12 to 50 percent.	Severe: slopes are 12 to 50 percent; high shrink-swell potential.	Severe: CH material; high shrink-swell potential.	Severe: slow permeability.	Severe: slopes are 12 to 50 percent.
McGary: Mg	Severe: somewhat poorly drained; clayey texture.	Severe: somewhat poorly drained; high shrink-swell potential.	Severe: CH material; high shrink-swell potential.	Severe: slow or very slow permeability.	Slight
McGary variant: Mh	Severe: somewhat poorly drained; floods.	Severe: somewhat poorly drained; floods.	Severe: floods	Severe: floods; somewhat poorly drained.	Severe: moderate permeability; floods.
Mine dump: Mn. No data. Material too variable.					

in town and country planning

which may have different properties and limitations. For this reason it is necessary to follow carefully the instructions for appear in the first column.]

Sanitary landfill (trench type)	Lawns and landscaping	Camp areas	Picnic areas	Playgrounds	Paths and trails
Severe: floods; somewhat poorly drained.	Moderate: floods	Severe: floods	Moderate: floods; somewhat poorly drained.	Severe: floods	Moderate: somewhat poorly drained; floods.
Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: poorly drained; floods.
Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slow permeability in fragipan.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: floods	Moderate: floods	Severe: floods	Moderate: floods	Severe: floods	Slight.
Severe: floods	Moderate: floods	Severe: floods	Moderate: floods	Severe: floods	Slight.
Severe: bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent.	Severe where slopes are 20 to 30 percent. Moderate where slopes are 12 to 20 percent.
Moderate: moderately well drained.	Slight. Moderate where severely eroded (GnB3).	Moderate: moderately well drained; slow permeability in fragipan.	Moderate: moderately well drained.	Moderate: moderately well drained; slow permeability in fragipan.	Slight.
Severe: floods; poorly drained.	Severe: floods; silty clay surface layer.	Severe: floods; poorly drained.	Severe: floods; poorly drained; clayey.	Severe: floods; poorly drained.	Severe: floods; poorly drained.
Severe: bedrock at a depth of 20 to 40 inches.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent.	Severe: slopes are 12 to 30 percent.	Severe where slopes are 20 to 30 percent. Moderate where slopes are 12 to 20 percent.
Moderate: moderately well drained.	Slight	Slight	Slight	Moderate: slow permeability in fragipan; slopes are 2 to 6 percent.	Slight.
Moderate: moderately well drained.	Moderate: for LoC: slopes are 6 to 12 percent. Severe for LoC3: severely eroded.	Moderate: slopes are 6 to 12 percent.	Moderate: slopes are 6 to 12 percent.	Severe: slopes are 6 to 12 percent.	Slight.
Severe: silty clay texture.	Moderate: slopes are 6 to 12 percent; silty clay surface layer.	Moderate: slopes are 6 to 12 percent; silty clay surface layer.	Moderate: slopes are 6 to 12 percent.	Severe: slopes are 6 to 12 percent.	Slight.
Severe: slopes are 12 to 50 percent; silty clay texture.	Severe: slopes are 12 to 50 percent.	Severe: slopes are 12 to 50 percent.	Severe: slopes are 12 to 50 percent.	Severe: slopes are 12 to 50 percent.	Severe: slopes are 12 to 50 percent.
Severe: somewhat poorly drained; silty clay texture.	Moderate: somewhat poorly drained.	Severe: slow or very slow permeability.	Moderate: somewhat poorly drained.	Severe: slow or very slow permeability; somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: floods; somewhat poorly drained.	Moderate: floods	Severe: floods	Moderate: floods; somewhat poorly drained.	Severe: floods; somewhat poorly drained.	Moderate: somewhat poorly drained.

TABLE 8.—*Limitations to be considered in*

Soil series and map symbols	Shallow excavations	Buildings of three stories or less	Local roads and streets	Septic tank absorption fields	Sewage lagoons
Mine wash: Mw. No data. Material too variable.					
Otwell: OtB	Moderate: moderately well drained to well drained; floods.	Severe: floods	Moderate: floods	Severe: slow permeability in fragipan; floods.	Severe: floods
*Ramsey: RsF For Steinsburg part, see Steinsburg series. Rock outcrop not rated.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches; slopes are 20 to 50 percent.	Severe: bedrock at a depth of 8 to 20 inches; slopes are 20 to 50 percent.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.
Rock outcrop. No data. Material too variable.					
Sadler: SdB	Moderate: moderately well drained.	Moderate: moderately well drained.	Moderate: ML and CL material.	Severe: slow permeability in fragipan.	Moderate: slopes are 2 to 6 percent.
Steff: Sf	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
*Steinsburg: SnE For Ramsey part, see Ramsey series.	Severe: slopes are 20 to 50 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 20 to 50 percent; bedrock at a depth of 20 to 40 inches.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent; bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.
Stendal: Ss	Severe: floods; somewhat poorly drained.	Severe: floods; somewhat poorly drained.	Severe: floods	Severe: floods; somewhat poorly drained.	Severe: floods
Strip mine: St. No data. Material too variable.					
Waverly: Wb	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods
Weinbach: Wh	Severe: somewhat poorly drained; floods.	Severe: somewhat poorly drained; floods.	Moderate: somewhat poorly drained; floods.	Severe: somewhat poorly drained; floods; slow permeability in fragipan.	Severe: floods
Wellston: WlC, WpCe3	Moderate: slopes are 6 to 12 percent; bedrock at a depth of 40 to 60 inches.	Moderate: slopes are 6 to 12 percent; bedrock at a depth of 40 to 60 inches.	Moderate: ML or CL material; slopes are 6 to 12 percent.	Moderate: bedrock at a depth of 40 to 60 inches.	Severe: slopes are 6 to 12 percent.
WlD	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Moderate: bedrock at a depth of 40 to 60 inches.	Severe: slopes are 12 to 20 percent.
Zanesville: ZnB	Moderate: moderately well drained to well drained.	Moderate: moderately well drained to well drained.	Moderate: ML or CL material.	Severe: slow permeability in fragipan.	Moderate: slopes are 2 to 6 percent; moderate permeability below fragipan.
ZnC, ZnC3	Moderate: moderately well drained to well drained; slopes are 6 to 12 percent.	Moderate: moderately well drained to well drained; slopes are 6 to 12 percent.	Moderate: ML or CL material; slopes are 6 to 12 percent.	Severe: slow permeability in fragipan.	Severe: slopes are 6 to 12 percent.
ZnD3	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Severe: slow permeability in fragipan; slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.

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Sanitary landfill (trench type)	Lawns and landscaping	Camp areas	Picnic areas	Playgrounds	Paths and trails
Severe: floods	Moderate: floods	Moderate: moderately well drained to well drained.	Slight	Moderate: slopes are 2 to 6 percent.	Slight.
Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches; slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.
Moderate: moderately well drained.	Slight	Moderate: moderately well drained; slow permeability in fragipan.	Moderate: moderately well drained.	Moderate: moderately well drained; slow permeability in fragipan.	Slight.
Severe: floods	Moderate: floods	Severe: floods	Moderate: floods	Severe: floods	Slight.
Severe: bedrock at a depth of 20 to 40 inches.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.	Severe: slopes are 20 to 50 percent.
Severe: floods; somewhat poorly drained.	Moderate: floods	Severe: floods	Moderate: floods; somewhat poorly drained.	Severe: floods	Moderate: somewhat poorly drained; floods.
Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.	Severe: floods; poorly drained.
Severe: somewhat poorly drained; floods.	Moderate: somewhat poorly drained; floods.	Moderate: somewhat poorly drained; floods.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Severe: bedrock at at a depth of 40 to 60 inches.	Moderate for WlC: slopes are 6 to 12 percent. Severe for WpCe: severely eroded.	Moderate: slopes are 6 to 12 percent.	Moderate: slopes are 6 to 12 percent.	Severe: slopes are 6 to 12 percent.	Slight.
Severe: bedrock at a depth of 40 to 60 inches.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Moderate: slopes are 12 to 20 percent.
Moderate: moderately well drained to well drained.	Slight	Slight	Slight	Moderate: slow permeability in fragipan; slopes are 2 to 6 percent.	Slight.
Moderate: moderately well drained to well drained.	Moderate for ZnC: slopes are 6 to 12 percent. Severe for ZnC3: severely eroded.	Moderate: slopes are 6 to 12 percent.	Moderate: slopes are 6 to 12 percent.	Severe: slopes are 6 to 12 percent.	Slight.
Moderate: moderately well drained to well drained.	Severe: slopes are 12 to 20 percent; severely eroded.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Severe: slopes are 12 to 20 percent.	Moderate: slopes are 12 to 20 percent.

fragments and rock outcrop, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Paths and trails are used for local and cross country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the period of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Formation, Morphology, and Classification of the Soils

This section describes the major factors that affect the formation and morphology of the soils of Hopkins County. It explains briefly the system of soil classification and classifies the soils by higher categories of that system.

Factors of Soil Formation

The factors that determine the kind of soil that forms are climate; the composition of the parent material; topography, or relief; plant and animal life; and time. Soil is formed by the interaction of these five factors. The relative influence of each factor varies from place to place, and each modifies the effect of the other four. In some areas one factor may dominate in the formation of soil characteristics, and in other areas another factor may dominate. Although climate and plant and animal life are not likely to vary greatly in an area the size of a county, there may be many local differences in relief and parent material.

Climate

The soils in Hopkins County formed in a temperate, moist climate that is relatively the same throughout the county, and little difference in soil formation results from it. Since the soils are frozen only a few inches for short periods, rocks and minerals are weathering almost continually.

The high rainfall leaches the colloidal and soluble materials to a high degree. As a result, the soils of Hopkins County are mostly highly weathered, leached, and acid. For more detailed information on climate, see the climate section in "General Nature of the County."

Plant and animal life

All living organisms are important to soil formation. These include vegetation, animals, bacteria, and fungi. The vegetation is generally responsible for the amount of organic matter, color of the surface layer, and, in part, for the amount of nutrients. Most of the soils in Hopkins County formed under hardwood forest. If these soils are still in woodland, they have a thin, dark-colored surface layer that is lower in content of organic matter than that of soils that formed under grass. If they are plowed, the dark-colored layer is mixed with the lighter colored layer below it. Earthworms and burrowing animals help keep the soil open and porous and mix organic matter and mineral soil by moving soil to the surface. Bacteria and fungi decompose organic matter, thus releasing nutrients for plant food, and fix nutrients from the air. Man has greatly influenced the surface layer by clearing the forest and plowing, and thus causing accelerated erosion. Drainage, irrigation, new cultivation practices, fertilization, and the introduction of new plants influence future soil formation.

Parent material

Parent material is the unconsolidated mass from which soils are formed. It determines the mineralogical and chemical composition of the soil and, to a large extent, the rate that soil-forming processes take place. The four kinds of parent material in which Hopkins County soils formed are material that weathered from rocks in place (residuum), material that was deposited by streams (alluvium), material washed or moved by gravity from hillsides and deposited as foot slopes (colluvium), and silty material deposited by wind (loess).

The rock formations in Hopkins County generally are in horizontal beds interrupted by numerous faults and dipping slightly to the north. They are of Pennsylvanian age. All of the parent material except that derived from clayey alluvium is acid.

Most upland soils in the northern half of the county formed in one of two ways. The soils on steep hillsides formed in material weathered from interbedded shale and sandstone covered with a mantle of loess. Examples are the Frondorf and Wellston soils, both of which are high in content of silt in the surface layer and have more clay or sand in the lower part of the subsoil or in the substratum. The gently sloping soils on ridgetops formed in loess 48 inches or more thick and have a profile that is high in content of silt. Examples are the Loring, Grenada, and Calloway soils.

The soils in the southern uplands formed in material weathered from sandstone and shale and a thin loess mantle. Sadler soils are examples. They are high in content of silt in the surface layer and subsoil, and the content of sand increases in the substratum, which formed in residuum. The steep soils in the southwestern part of the county formed in material weathered from soft sandstone. Steinsburg and Ramsey soils are examples. These soils are loamy and have a significant content of sand.

The clayey soils on the flood plain of the Pond River and on the flood plain at the lower end of Clear Creek formed in clayey alluvium that settled in slack water. Karnak and McGary soils are examples. The alluvium or mixtures of alluvium and colluvium in the other parts of the county washed or were derived from loess and sandstone and shale. The soils formed in these materials are loamy and are high in content of silt. Examples of these are Belknap, Collins, Waverly, and Bonnie soils.

Relief

Relief affects soil formation mainly through its influence on the amount of rainfall that enters the soil and on the amount that runs off. It also greatly affects the amount of erosion. The relief in Hopkins County ranges from steep and strongly dissected to nearly level and gently rolling.

Steep soils are likely to be shallow because much of the rainfall runs off and carries soil material with it, and little

water infiltrates and moves downward to cause leaching and translocation of clay. Ramsey soils are steep and shallow.

Sloping or moderately steep soils that formed in areas where runoff is moderate to rapid are generally well drained, are moderately deep to deep, and have a bright-colored, unmottled subsoil. Enough water infiltrates and moves downward, causing leaching and translocation of clay from the surface layer into the subsoil. Wellston and Frondorf soils are examples.

More gently sloping soils formed in areas where runoff is slower, and these soils are likely to be deep and to have well-defined profiles. Enough water moves downward to cause leaching and a pronounced accumulation of clay in the subsoil. The soils generally exhibit some evidence of wetness such as mottling in the subsoil, and they generally have a fragipan. Grenada and Zanesville soils are examples.

Nearly level or depressional soils are likely to be saturated for long periods, because nearly all of the rainfall infiltrates and little runs off. The excessive amount of water restricts air movement, reduces iron compounds, and causes gray colors in the subsoil. Bonnie, Calloway, and Belknap soils are examples of nearly level soils that are affected by excessive wetness.

Relief also modifies some of the effect of climate. Slopes that face north have a lower soil temperature than slopes that face south, because north slopes receive less heat from the sun. In Hopkins County slope direction has only a slight influence on soil formation.

Time

Time is required for a soil to be formed from a parent material. The amount of time required depends on the other soil-forming processes. For example, a soil forms in less time in a warm moist climate than in a cool dry climate. Some parent material is more resistant to the soil-forming processes than others. The maturity of a soil is determined by the relative degree of profile formation rather than by the number of years that a soil has been forming. In Hopkins County Zanesville soils are classified as more mature than Collins soils because they are deep to bedrock, have distinct horizons, and have a definite arrangement of soil particles. Collins soils are considered younger because they have only faint horizons. They are on flood plains where alluvium is still accumulating. Ramsey soils are steep, and because the soil is removed by erosion nearly as fast as it is formed they are shallow and have a weakly defined profile.

Morphology of Soils

This section briefly describes horizon nomenclature and the processes involved in horizon formation.

The results of the soil-forming processes can be observed in the different layers, or soil horizons, in the profile. The profile extends from the soil surface downward to materials that are little changed by soil-forming processes. Most soils contain three major horizons called A, B, and C (*8*). These major horizons can be further subdivided by the use of numbers and letters to indicate changes within the major horizon.

The A horizon is the surface layer. It is the layer that has the maximum accumulation of organic matter. It is also the layer of maximum leaching or eluviation of clay and iron.

The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation or illuviation of clay, iron, aluminum, or other compounds leached from the surface layer. The B horizon commonly has blocky structure and is generally more firm and lighter in color than the A horizon.

The C horizon is below the A or B horizon. It consists of material that is modified by weathering but is altered little by the soil-forming processes.

In Hopkins County many processes are involved in the formation of soil horizons. The more important of these are the accumulation of organic matter, the leaching of soluble salts, the reduction and transfer of iron, the formation and translocation of clay minerals, and the formation of structure. Such processes are continually taking place and have been going on for thousands of years.

The accumulation and incorporation of organic matter in the soil is the result of the decomposition of plant and animal life. These additions of organic matter are responsible for the darkening of the surface horizon. Once this organic matter is lost, it generally takes a long time to replace it.

Most well drained and moderately well drained soils on the uplands in Hopkins County have a yellowish-brown and strong-brown B horizon. These colors are caused mainly by iron oxides on the silt grains. This horizon also has moderate to strong blocky structure and has accumulations of translocated clay minerals.

A fragipan has formed in the B horizon of most of the moderately well drained and somewhat poorly drained soils on uplands and stream terraces. It is very firm and brittle when moist and very hard when dry. The soil particles are closely packed; therefore, the bulk density is high and the pore space is low. It is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons.

Gray colors are the result of the intense reduction of iron during soil formation, or they are caused by stagnant water. These colors are mainly associated with the more poorly drained soils. This process is called gleying. Moderately well drained and somewhat poorly drained soils have yellowish-brown and strong-brown mottles, which indicate segregation of iron. In poorly drained soils, such as Bonnie and Waverly soils, the B and C horizons are grayish colored, which indicates reduction and transfer of iron by removal in solution.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 9, the soil series of Hopkins County are placed in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Alf-i-sol).

SUBORDER. Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Udalf* (*Ud,* meaning humid or moist, and *alf,* from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Hapludalfs (*Hapl,* meaning simple horizons, *ud* for humid or moist, and *alf,* from Alfisol).

SUBGROUP. Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also

TABLE 9.—*Soil series classified according to the current system of classification*

Series	Current classification		
	Family	Subgroup	Order
Belknap	Coarse-silty, mixed, acid, mesic	Aeric Fluvaquents	Entisols.
Bonnie	Fine-silty, mixed, acid, mesic	Typic Fluvaquents	Entisols.
Calloway	Fine-silty, mixed, thermic [1]	Glossaquic Fragiudalfs	Alfisols.
Collins	Coarse-silty, mixed, acid, thermic [1]	Aquic Udifluvents	Entisols.
Cuba	Fine-silty, mixed, mesic	Fluventic Dystrocrepts	Inceptisols.
Frondorf	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Grenada	Fine-silty, mixed, thermic [1]	Glossic Fragiudalfs	Alfisols.
Karnak	Fine, montmorillonitic, non-acid, mesic	Vertic Haplaquepts	Inceptisols.
Lenberg	Fine, mixed, mesic	Ultic Hapludalfs	Alfisols.
Loring	Fine-silty, mixed, thermic [1]	Typic Fragiudalfs	Alfisols.
Markland	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
McGary	Fine, mixed, mesic	Aeric Ochraqualfs	Alfisols.
McGary variant	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Otwell	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.
Ramsey	Loamy, siliceous, mesic	Lithic Dystrochrepts	Inceptisols.
Sadler	Fine-silty, mixed, mesic	Glossic Fragiudalfs	Alfisols.
Steff	Fine-silty, mixed, mesic	Fluvaquentic Dystrochrepts	Inceptisols.
Steinsburg [2]	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Stendal	Fine-silty, mixed, acid, mesic	Aeric Fluvaquents	Entisols.
Strip mine		Orthents and Ochrepts	Entisols and Inceptisols.
Waverly	Coarse-silty, mixed, acid, thermic [1]	Typic Fluvaquents	Entisols.
Weinbach	Fine-silty, mixed, mesic	Aeric Fragiaqualfs	Alfisols.
Wellston	Fine-silty, mixed, mesic	Ultic Hapludalfs	Alfisols.
Zanesville	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.

[1] Hopkins County is in a transition zone between mesic and thermic soil temperature regimes and thermic soils have been correlated without considering them as taxadjuncts.

[2] The Steinsburg soils in Hopkins County are taxadjuncts to the Steinsburg series because the solum is thicker than normal for the series. In all other characteristics, they are within the normal range for the series.

be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Hapludalfs (a typical Hapludalf).

FAMILY. Soil families are established within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae. An example is the fine, mixed, mesic family of Typic Hapludalfs.

SERIES. The series consists of a group of soils that formed in a particular kind of parent material and have genetic horizons that are similar in differentiating characteristics and in arrangement of the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical characteristics. Soils of one series may have different surface textures.

General Nature of the County

This section provides general information about Hopkins County. It briefly describes the climate, history and development, relief and drainage, and farming of the county.

Climate [4]

This summary was prepared from data recorded at Madisonville and is representative of this general area of Kentucky.

The climate of Hopkins County is temperate: winters are moderately cold, and summers are warm and humid. Precipitation is fairly well distributed throughout the year, with no distinct wet season and no dry season. Table 10 gives data on temperature and precipitation. Table 11 gives the probabilities of freezing temperatures after specified dates in spring and before specified dates in the fall (*10*). The nighttime temperature drops to 32° F or lower on an average of 87 days (*10*) a year, and a daily freeze-thaw cycle is normal in winter. The daytime temperature rises above freezing on all but 8 of these days. A temperature of zero or lower occurs on an average of 1 day each winter. The average length of the growing season is about 186 days.

Annual precipitation totals, on the average, a little more than 46 inches. Rainfall is fairly evenly distributed through the year. Precipitation of 0.1 inch or more occurs on an average of 78 days a year. At sometime in almost every year, 1.3 inches or more of rain will fall in a 1-hour period. Once in 5 years, at least 3.7 inches of rainfall in a 12-hour period can be expected. Thunderstorms occur on an average of about 52 days each year. They are most frequent in spring and summer but can occur in any month. They cause most of the short-duration, high-intensity type of rainfall. Low-intensity rainfall that lasts for several days in late spring can delay planting. Soils that are most likely to be affected are those that drain slowly or have a seasonal high water table, such as McGary and Bonnie soils.

Fall typically brings long periods of mild weather favorable for harvesting crops.

Snowfall is quite variable from year to year. The greatest annual total recorded for the period 1931 to 1960 was 28.5 inches in 1960; the least recorded was a trace, in 1956. The average annual snowfall is about 8.2 inches.

[4] ALLEN B. ELAM, JR., State climatologist, Environmental Science Services Administration, National Weather Service, provided the data for this section.

History and Development

Hopkins County was formed in 1807 by a division of Henderson County. It was named in honor of Samuel Hopkins, who was a General in the Revolutionary Army. Madisonville, the county seat, was incorporated in 1810. In 1860 some of the northern part of the county was taken to form Webster County.

In the early development of Hopkins County, farming was the prime source of income. Around the turn of the century, coal mining became important in the county. Farming is still a major source of income, but much industry has located in the county in recent years. In 1972, 35 manufacturing and mining firms employed more than 4,000 workers.

Transportation facilities include two limited access highways, the Western Kentucky Parkway that runs in an east-west direction and the Pennyrile Parkway that runs in a north-south direction. A network of Federal, State, and county highways give access to nearly all parts of the county. Hopkins County is served by two railroads, and bus service is available. Madisonville airport near Anton serves the county with a 4,200 foot paved runway. Charter service is available, but there are no scheduled flights.

A city park at Madisonville, golf courses, swimming pools, tennis courts, playgrounds, and numerous fishing lakes are among the recreational facilities in the county. Pennyrile Forest State Park borders the county on the southwest corner. Several large lakes and State parks are within a 60-mile radius of the county seat.

Hopkins County is served by the Hopkins County Public School System and independent school system in Earlington and Dawson Springs. Among the specialized educational institutions located in the county are Madisonville Community College, Madisonville Area Vocational School, Learning Resource Center, Health Occupations School, and the School of Industrial Electricity.

The population of Hopkins County has shown a continuous increase. In 1810 the population was 2,964. It increased to 9,171 by 1840, to 13,827 by 1870, and to 38,392 in 1972.

TABLE 10.—*Temperature and precipitation data*

[Based on 1931-60 records at Madisonville]

Month	Temperature				Precipitation		
	Average daily maximum	Average daily minimum	Average monthly highest	Average monthly lowest	Average monthly total	One year in 10 will have [1]— Less than—	One year in 10 will have [1]— More than—
	°F	°F	°F	°F	Inches	Inches	Inches
January	47	28	67	6	5.0	1.3	9.6
February	50	30	70	9	3.8	1.4	6.5
March	58	36	77	18	4.9	1.9	8.6
April	70	47	86	29	4.1	2.0	6.8
May	79	55	91	39	4.1	1.7	7.2
June	88	64	97	49	3.9	.9	7.6
July	91	67	99	55	4.1	1.6	7.5
August	90	66	98	52	3.6	1.0	6.8
September	84	58	96	40	2.8	.7	5.5
October	74	47	88	30	2.5	.8	4.5
November	59	36	79	17	3.9	1.5	6.9
December	48	30	67	10	3.6	1.7	5.6
Year	70	47	[2] 101	[3] 0	46.4	[4] 36.1	[4] 55.7

[1] From "Dependability of Monthly Precipitation in Kentucky." Progress Report 183. Univ. of Ky. Exp. Sta.
[2] Average annual highest temperature.
[3] Average annual lowest temperature.
[4] 1890-1971 data, Earlington and Madisonville.

Relief and Drainage

Hopkins County ranges from nearly level to very steep in relief. About 36 percent of the county is nearly level. Gently sloping to sloping soils make up about 35 percent of Hopkins County.

Hopkins County is drained by Pond River and its tributaries on the east boundary and by Tradewater River and its tributaries on the west boundary. The water from Pond River flows into the Green River, and the water from Tradewater River flows into the Ohio River.

Farming

Farming has always provided much of the income in Hopkins County. According to the U.S. Census of Agriculture, livestock and livestock products make up about half of all products sold, and crops make up about one-half in most years.

The number of beef cattle and hogs has increased in recent years. Dairy cattle and poultry numbers have decreased sharply.

In 1939, 2,402 acres of tobacco were harvested in Hopkins County. Tobacco acreage dropped to 340 acres in 1971. Wheat acreage has also dropped off sharply. The number of acres planted to corn and hay crops decreased slightly during this period. Soybean production increased sharply from 7,222 acres in 1939 to 31,200 acres in 1971. The total acreage of crops has decreased.

Total acreage in farms in 1939 was 236,900. There were 2,343 farms with an average size of 101 acres. By 1969 the total acreage in farms had dropped to 170,456, and the number of farms had dropped to 890. The average farm size gradually increased to 191 acres in 1969.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Dates for given probability and temperature		
	24° F or lower	28° F or lower	32° F or lower
Spring:			
1 year in 10 later than	April 6	April 11	April 29
2 years in 10 later than	March 31	April 5	April 24
5 years in 10 later than	March 19	March 26	April 14
Fall:			
1 year in 10 earlier than	October 24	October 15	October 2
2 years in 10 earlier than	October 30	October 21	October 7
5 years in 10 earlier than	November 9	October 30	October 17

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Glossary

Acidity. See Reaction, soil.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (often with magensium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Cobble. A rounded or partly rounded fragment of rock 3 to 10 inches in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour cultivation. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Crop residue use. Using the part of the crop that is left in the field after harvest, by leaving it on the surface, or by plowing it into the surface layer. The crop residue protects the soil during that part of the year when losses from erosion are the most critical, and it helps conserve moisture.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gravel. Rounded fragments less than 3 inches in diameter and larger than 2 millimeters.

Green manure crop. Any crop grown for the purpose of being turned under while green or soon after maturity to improve the soil.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other materials by percolating water.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Minimum tillage. Limiting the number of cultural operations to those that are properly timed and essential to produce a crop and prevent soil damage.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Mulch planting. Planting row crops in grass, stubble, or crop residue without prior seedbed preparation, and performing subsequent operations in a manner that will keep protective amounts of residue on or near the surface of the soil during the growing season.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in

the A horizon and upper part of the B horizon and mottling in the lower part of the B horizon and the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residuum is not soil but is frequently the material in which a soil has formed.

Root zone. The part of the soil that is penetrated, or can be penetrated by plant roots. Terms used to indicate the depth of the root zone in this soil survey are: Very shallow, less than 10 inches; shallow, 10 to 20 inches; moderately deep, 20 to 30 inches; and deep, 30 inches or more.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Shale. A sedimentary rock formed by hardening of clay deposits.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.005 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slack-water areas. Bottom lands where clay sediments have settled out of suspension.

Slope. Terms used in this survey to describe the range of slopes are: nearly level, 0 to 2 percent; gently sloping, 2 to 6 percent; sloping, 6 to 12 percent; moderately steep, 12 to 20 percent; steep, 20 to 30 percent; and very steep, 30 to 50 percent.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles) adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Underlying material. Any layer lying below the solum or true soil, the C or R horizon.

Upland. Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

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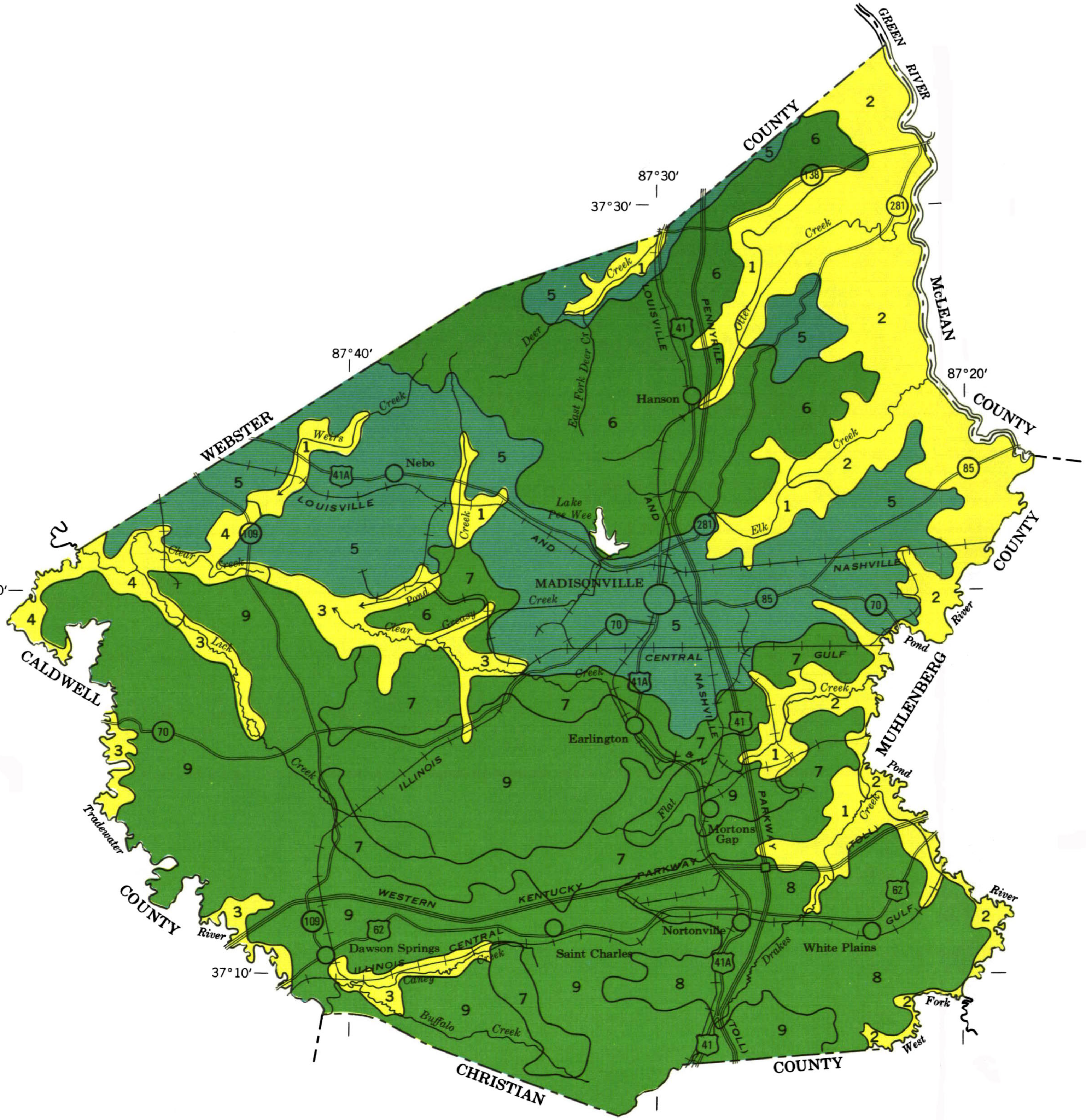


SOIL ASSOCIATIONS*

SOILS FORMED IN ALLUVIUM ON FLOOD PLAINS AND STREAM TERRACES

1	Belknap-Waverly association: Deep, somewhat poorly drained and poorly drained, nearly level, medium-textured soils on flood plains
2	Karnak-McGary-Belknap association: Deep, poorly drained and somewhat poorly drained, nearly level, fine-textured and medium-textured soils on flood plains and stream terraces
3	Bonnie-Steff-Stendal association: Deep, poorly drained to moderately well drained, nearly level, medium-textured soils on flood plains
4	Bonnie-Karnak association: Deep, poorly drained, nearly level, medium-textured and fine-textured soils on flood plains

SOILS FORMED IN LOESS ON UPLANDS

5	Loring-Grenada-Calloway association: Deep, moderately well drained and somewhat poorly drained, nearly level to sloping, medium-textured soils on uplands

SOILS FORMED MAINLY IN A LOESS MANTLE AND IN THE UNDERLYING MATERIAL WEATHERED FROM SANDSTONE AND SHALE

6	Loring-Frondorf-Zanesville association: Deep and moderately deep, moderately well drained and well drained, gently sloping to steep, medium-textured and moderately fine textured soils on uplands
7	Strip mine-Frondorf association: Deep and moderately deep, well drained, moderately steep to very steep, medium-textured and moderately fine textured soils on uplands
8	Zanesville-Sadler association: Deep, well drained to moderately well drained, gently sloping to moderately steep, medium-textured soils on uplands
9	Zanesville-Frondorf-Belknap association: Deep and moderately deep, well drained to somewhat poorly drained, nearly level to steep, medium-textured soils on uplands and flood plains

* Terms for texture in the descriptive headings of the associations apply to the surface layer of the major soils.

Compiled 1975

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KENTUCKY AGRICULTURAL EXPERIMENT STATION

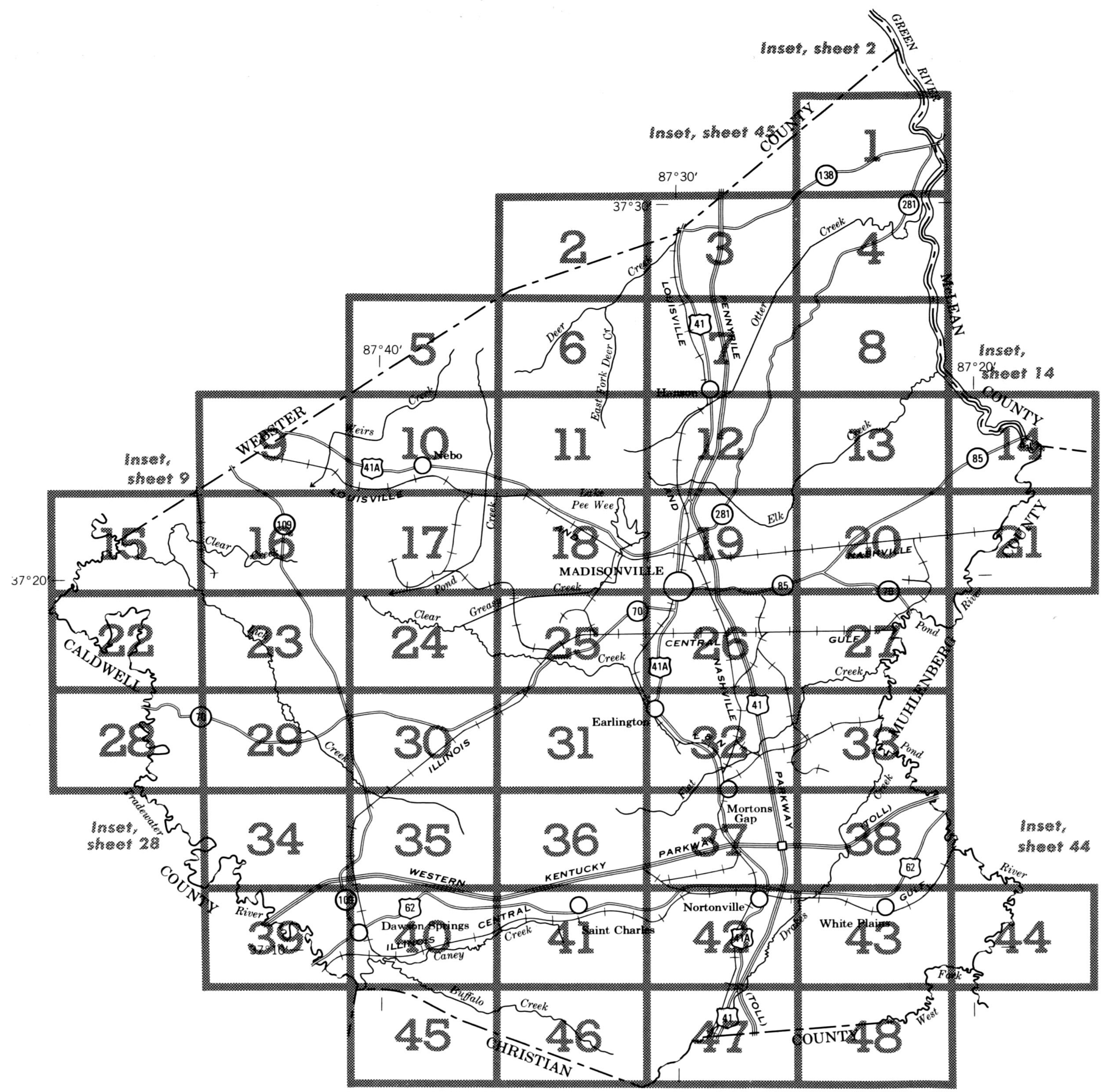
GENERAL SOIL MAP

HOPKINS COUNTY, KENTUCKY

Scale 1:253,440

1 0 1 2 3 4 Miles

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS
HOPKINS COUNTY, KENTUCKY

Scale 1:253,440

1 0 1 2 3 4 Miles

GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Capability unit Symbol	Woodland group Symbol
Bn	Belknap silt loam	11	IIw-1	1w1
Bo	Bonnie silt loam	12	IIIw-1	1w2
BP	Bonnie and Karnak soils, ponded	12	VIIw-1	------
Cc	Calloway silt loam	13	IIIw-3	1w1
Co	Collins silt loam	14	I-2	1w1
Cu	Cuba silt loam	14	I-1	1o1
FdE	Frondorf-Lenberg silt loams, 12 to 30 percent slopes	15	VIe-1	2r1 (N), 3r1 (S)
GnB	Grenada silt loam, 2 to 6 percent slopes	15	IIe-1	3o1
GnB3	Grenada silt loam, 2 to 6 percent slopes, severely eroded	16	IIIe-3	4o1
Gu	Gullied land	16	VIIe-3	------
Kb	Karnak silt loam, overwash	16	IIIw-5	1w2
Kc	Karnak silty clay	16	IIIw-4	1w2
LoB	Loring silt loam, 2 to 6 percent slopes	18	IIe-2	3o1
LoC	Loring silt loam, 6 to 12 percent slopes	18	IIIe-2	3o1
LoC3	Loring silty clay loam, 6 to 12 percent slopes, severely eroded	18	IVe-4	4o1
MbC3	Markland silty clay, 6 to 12 percent slopes, severely eroded	19	IVe-2	2c1
ME	Markland-Collins complex	19	VIIe-2	2c1
Mg	McGary silt loam	19	IIIw-2	3w1
Mh	McGary loam, loamy subsoil variant	20	IIw-2	2w1
Mn	Mine dump	20	-------	------
Mw	Mine wash	20	-------	------
OtB	Otwell silt loam, 2 to 6 percent slopes	21	IIe-1	3o1
RsF	Ramsey-Steinsburg-Rock outcrop complex, 30 to 50 percent slopes	22	VIIs-2	4d1 (N), 5d1 (S)
SdB	Sadler silt loam, 2 to 6 percent slopes	22	IIe-1	3o1
Sf	Steff silt loam	23	I-2	1w1
SnE	Steinsburg-Ramsey loams, 20 to 30 percent slopes	23	VIIe-1	2r1 (N), 3r1 (S)
Ss	Stendal silt loam	24	IIw-1	1w1
St	Strip mine	24	VIIs-1	------
Wb	Waverly silt loam	25	IIIw-1	1w2
Wh	Weinbach silt loam	26	IIIw-3	1w1
W1C	Wellston silt loam, 6 to 12 percent slopes	26	IIIe-1	2o1
W1D	Wellston silt loam, 12 to 20 percent slopes	26	IVe-1	2o1
WpC3	Wellston silty clay loam, 6 to 12 percent slopes, severely eroded	26	IVe-3	3o1
ZnB	Zanesville silt loam, 2 to 6 percent slopes	28	IIe-2	3o1
ZnC	Zanesville silt loam, 6 to 12 percent slopes	28	IIIe-2	3o1
ZnC3	Zanesville silt loam, 6 to 12 percent slopes, severely eroded	28	IVe-4	4o1
ZnD3	Zanesville silt loam, 12 to 20 percent slopes, severely eroded	28	VIe-2	4o1

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CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) (S)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Borrow pit (B.P.)

SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. The second letter is a capital if the mapping unit is broadly defined; otherwise, it is a small letter. The third letter, always a capital B, C, D, E, or F shows the slope. Symbols without slope letters are those of nearly level soils. A final number, 3 in the symbol shows that the soil is severely eroded.

SYMBOL	NAME
Bn	Belknap silt loam
Bo	Bonnie silt loam
BP 1/	Bonnie and Karnak soils, ponded
Cc	Calloway silt loam
Co	Collins silt loam
Cu	Cuba silt loam
FdE	Frondorf-Lathan silt loams, 12 to 30 percent slopes
GnB	Grenada silt loam, 2 to 6 percent slopes
GnB3	Grenada silt loam, 2 to 6 percent slopes, severely eroded
Gu	Gullied land
Kb	Karnak silt loam, overwash
Kc	Karnak silty clay
LoB	Loring silt loam, 2 to 6 percent slopes
LoC	Loring silt loam, 6 to 12 percent slopes
LoC3	Loring silty clay loam, 6 to 12 percent slopes, severely eroded
MbC3	Markland silty clay, 6 to 12 percent slopes, severely eroded
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Sf	Steff silt loam
SnE	Steinsburg-Ramsey loams, 20 to 30 percent slopes
Ss	Stendal silt loam
St	Strip mine
Wb	Waverly silt loam
Wh	Weinbach silt loam
W1C	Wellston silt loam, 6 to 12 percent slopes
W1D	Wellston silt loam, 12 to 20 percent slopes
WpC3	Wellston silty clay loam, 6 to 12 percent slopes, severely eroded
ZnB	Zanesville silt loam, 2 to 6 percent slopes
ZnC	Zanesville silt loam, 6 to 12 percent slopes
ZnC3	Zanesville silt loam, 6 to 12 percent slopes, severely eroded
ZnD3	Zanesville silt loam, 12 to 20 percent slopes, severely eroded

1/ The composition of these units is more variable than those of the others in the survey area, but has been controlled well enough to be interpreted for the expected uses of the soils.

(Joins inset, sheet 2)

1 515 000 FEET

445 000 FEET

435 000 FEET

1 535 000 FEET

(Joins sheet 4)

HOPKINS COUNTY, KENTUCKY NO. 1

(Joins inset, sheet 45)

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

1

N

1 Mile

5000 Feet

0

¼

½

¾

1

0 1000 2000 3000 4000 5000

Scale 1:20000

(2)

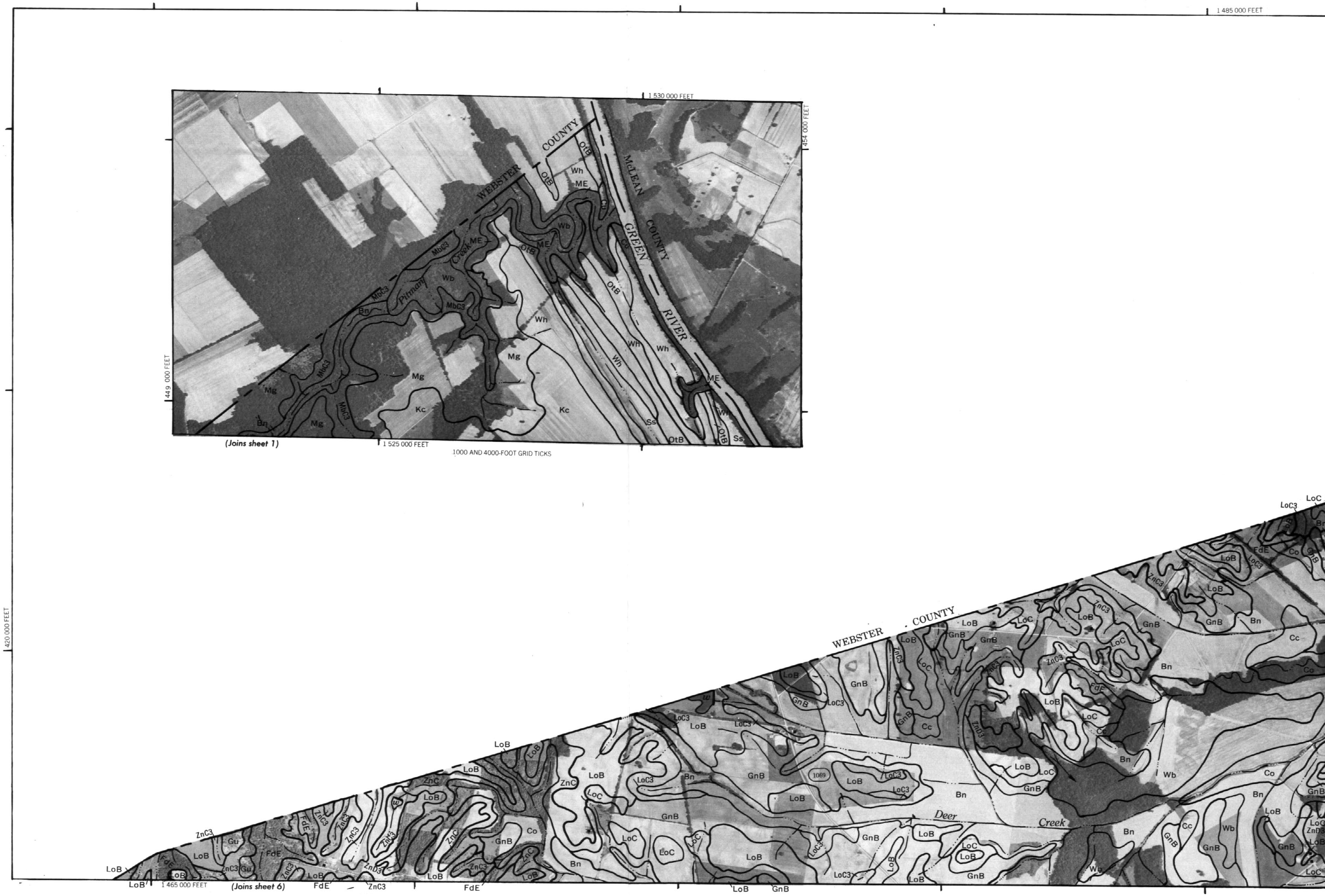
N

Scale 1:20000

1 Mile 5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000



HOPKINS COUNTY, KENTUCKY NO. 2

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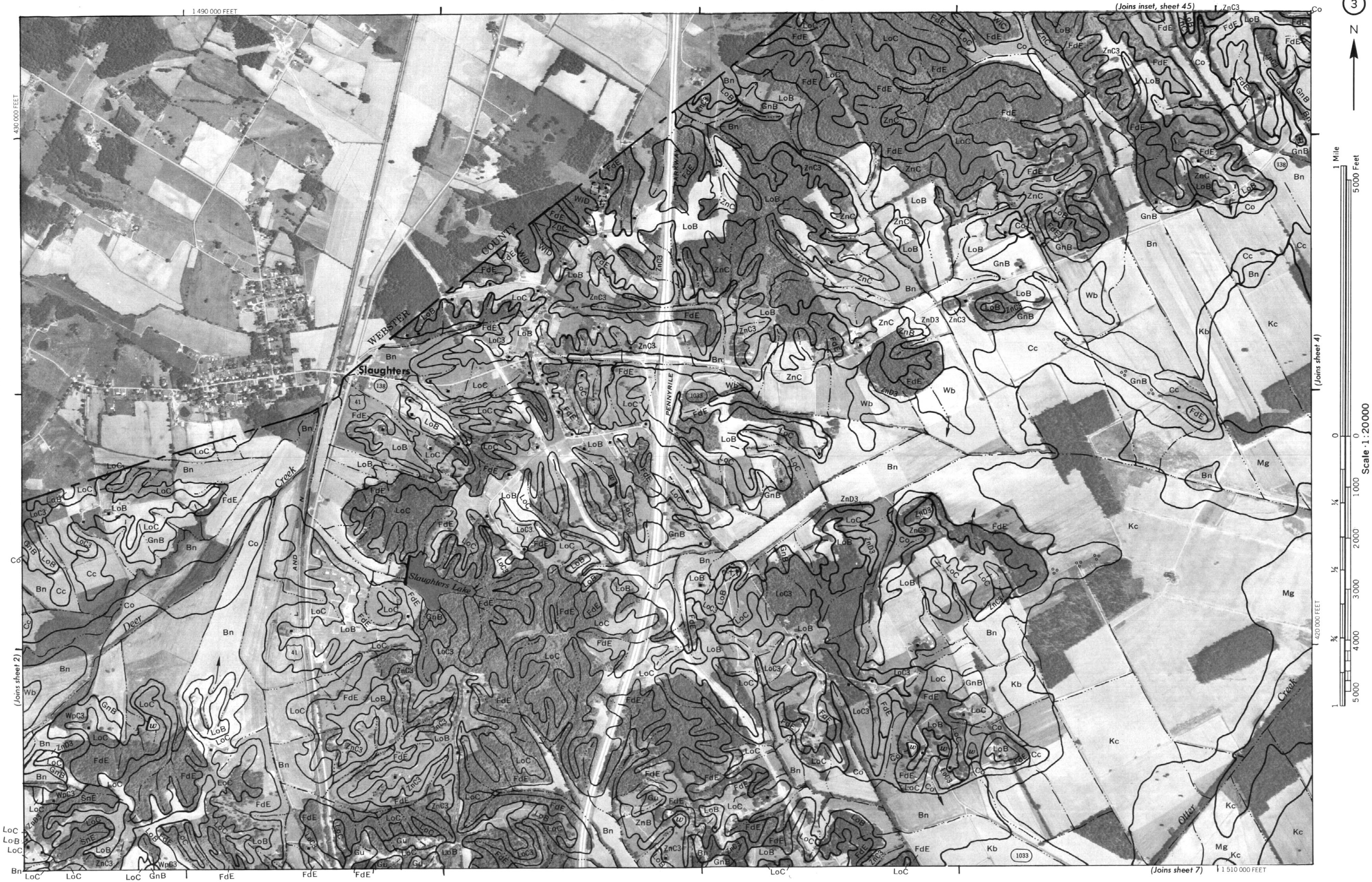

HOPKINS COUNTY, KENTUCKY NO. 3

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4

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 4

HOPKINS COUNTY, KENTUCKY NO. 4

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N

1 Mile
5000 Feet
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1
Scale 1:20000

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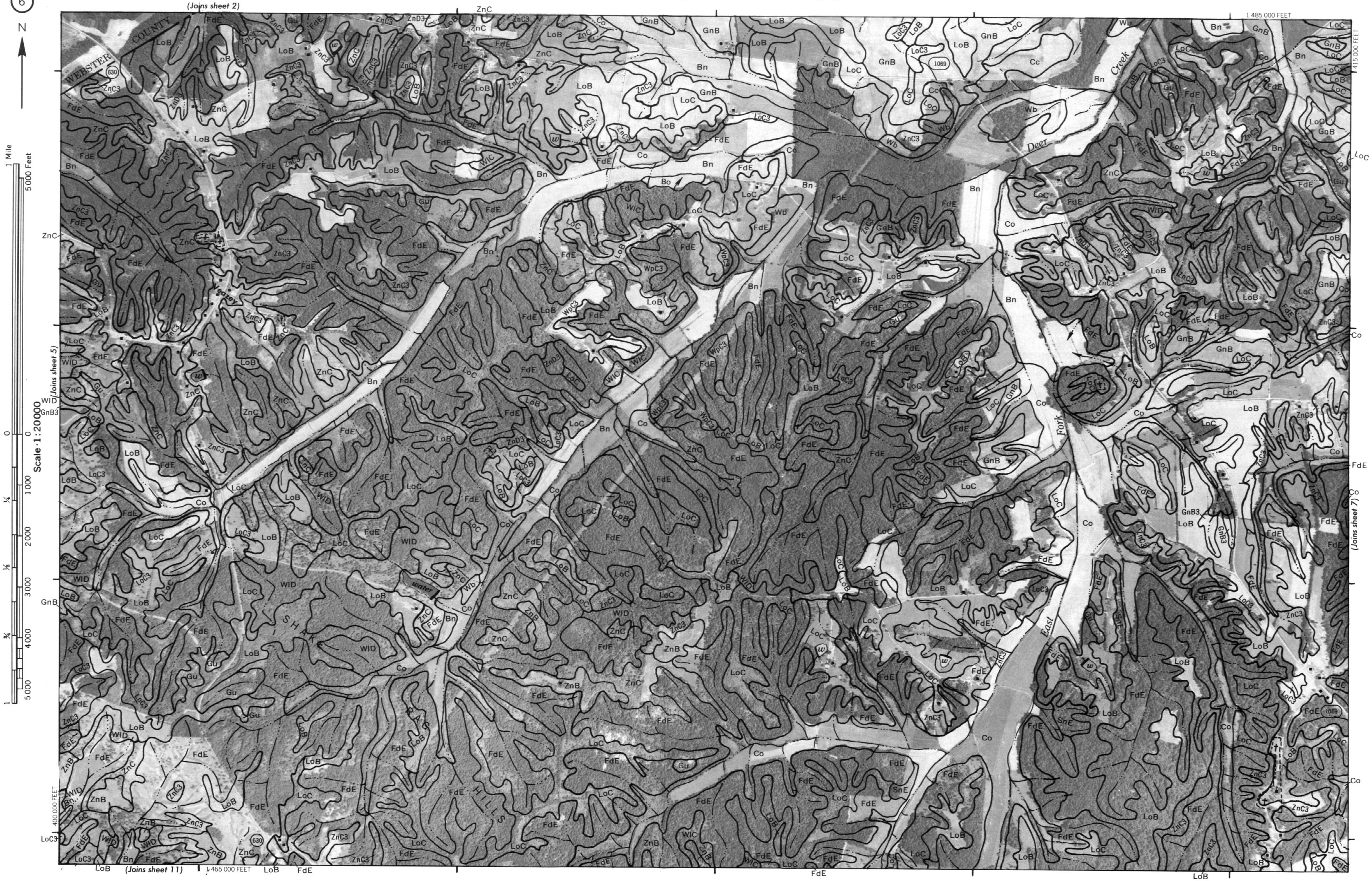
HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 6



HOPKINS COUNTY, KENTUCKY NO. 6

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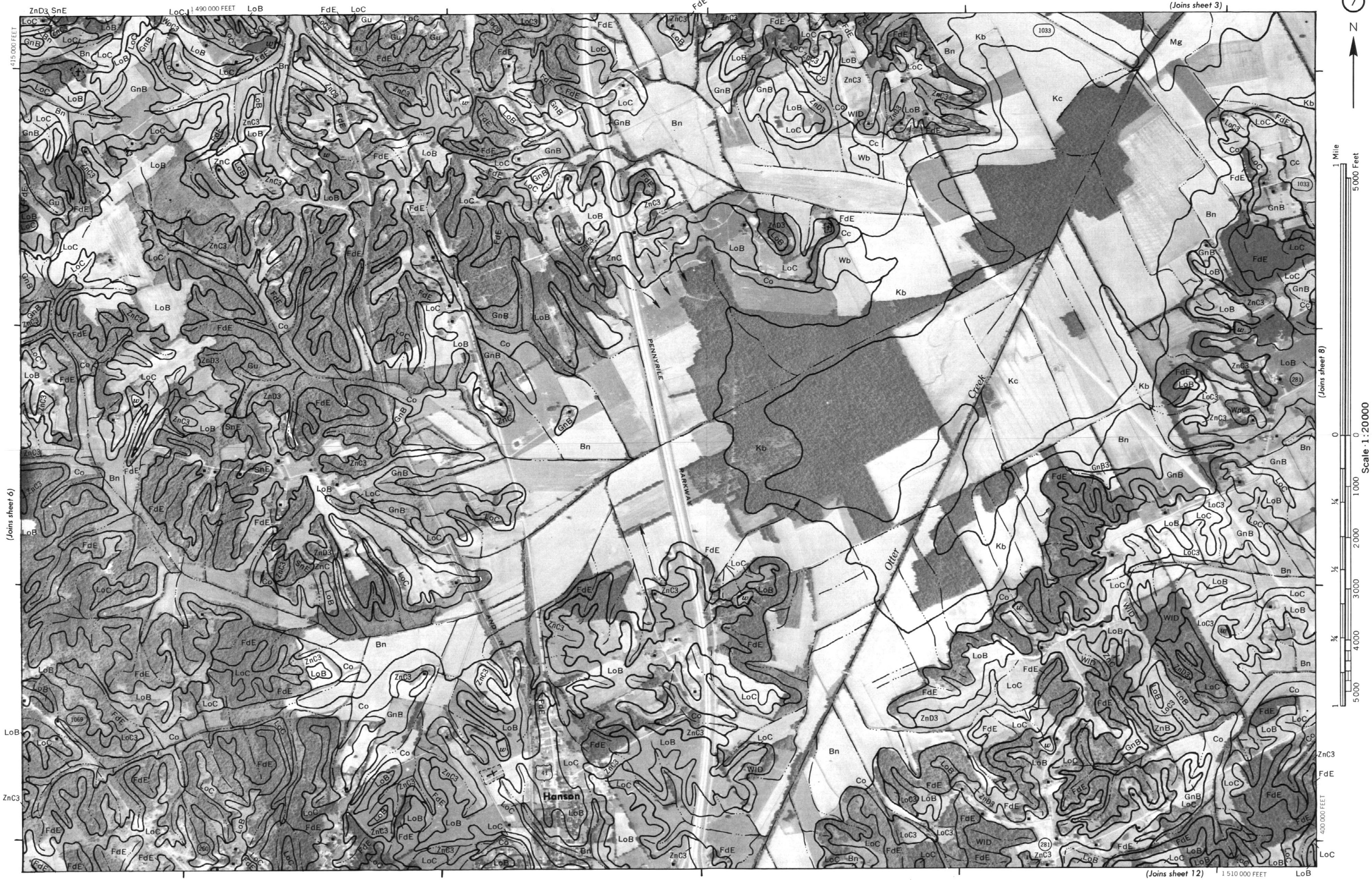

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HOPKINS COUNTY, KENTUCKY NO. 7

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 8

HOPKINS COUNTY, KENTUCKY NO. 8

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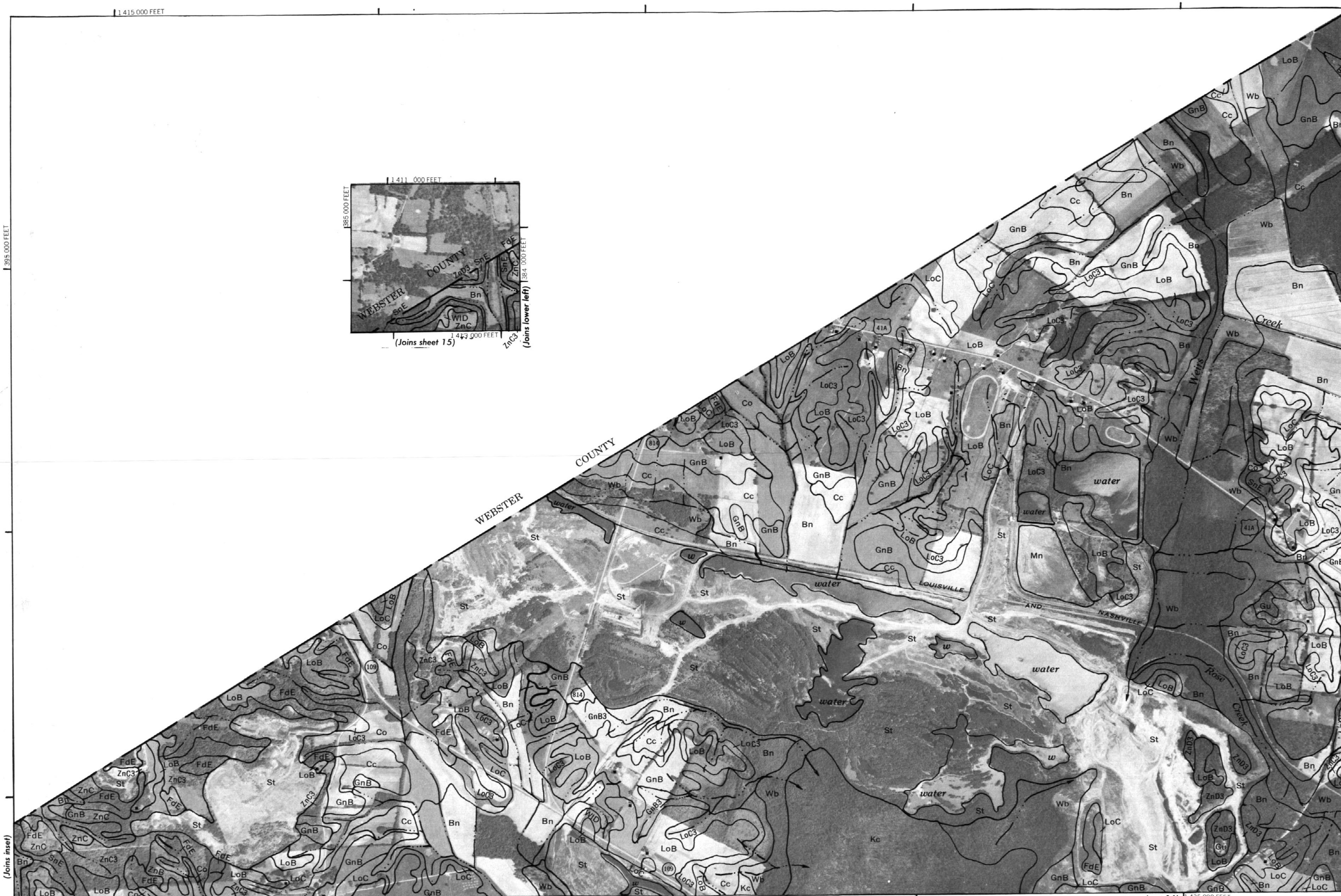
9

N



1 Mile
5000 Feet
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000
Scale 1:20000

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HOPKINS COUNTY, KENTUCKY NO. 9

HOPKINS COUNTY, KENTUCKY NO. 10

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11

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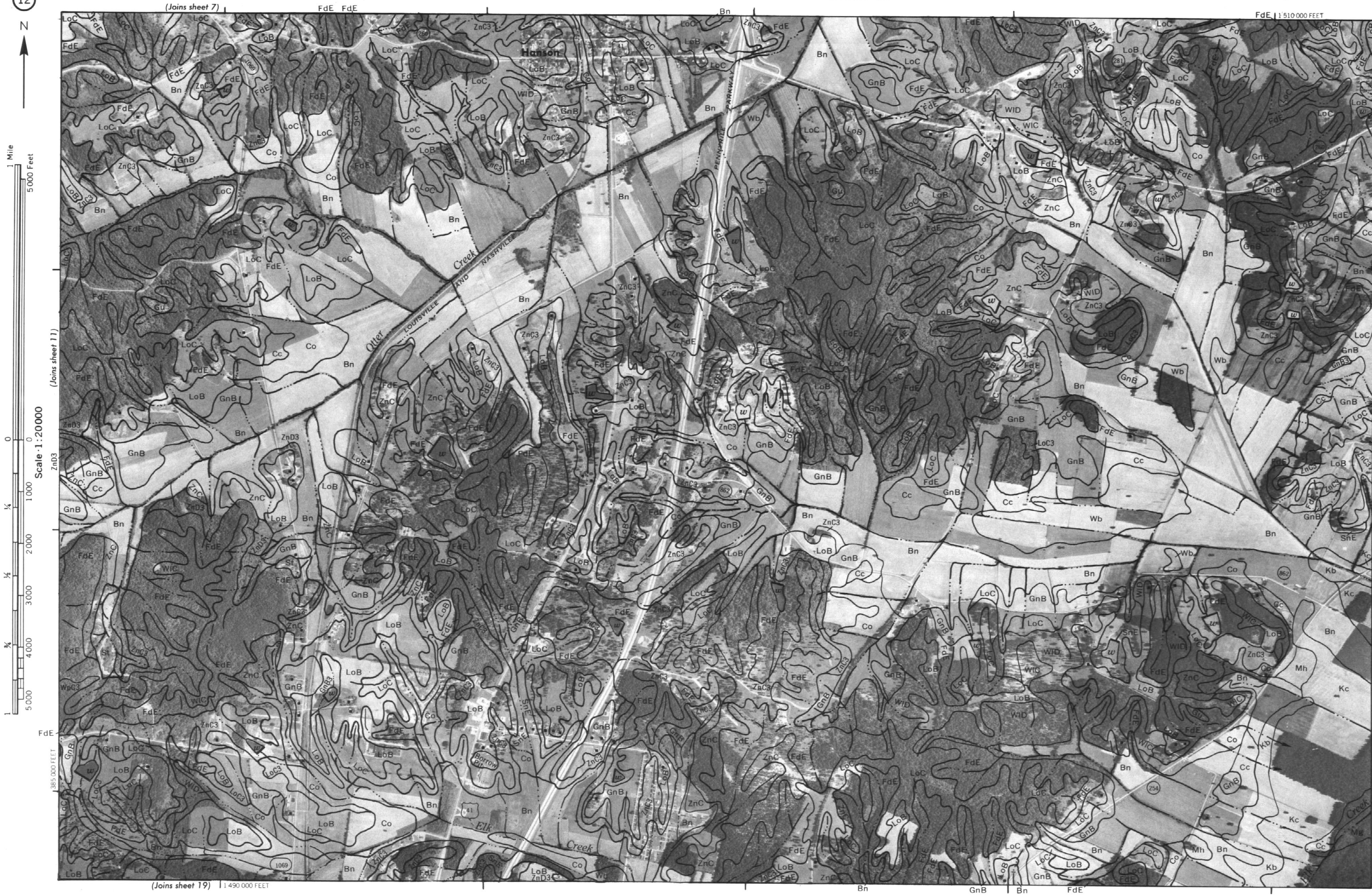
HOPKINS COUNTY, KENTUCKY NO. 11

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 12



HOPKINS COUNTY, KENTUCKY NO. 12

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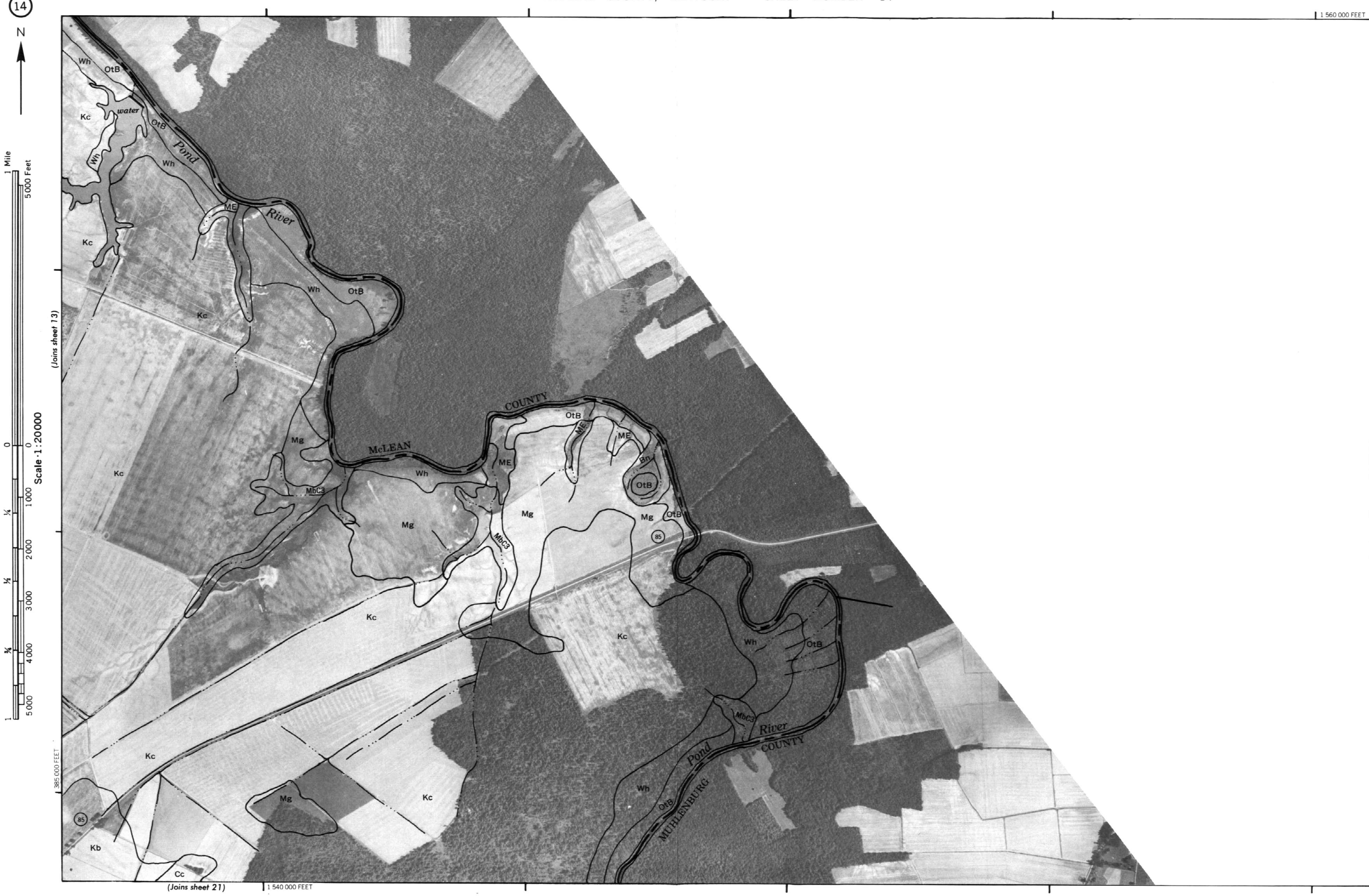
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 13



HOPKINS COUNTY, KENTUCKY NO. 14

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HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 15

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HOPKINS COUNTY, KENTUCKY NO. 15

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 16

HOPKINS COUNTY, KENTUCKY NO. 16

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HOPKINS COUNTY, KENTUCKY NO. 17

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HOPKINS COUNTY, KENTUCKY NO. 18

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Scale 1:20000

1 Mile
5000 Feet
0 1000 2000 3000 4000 5000

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HOPKINS COUNTY, KENTUCKY NO. 19

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 20

N

1 Mile
5000 Feet

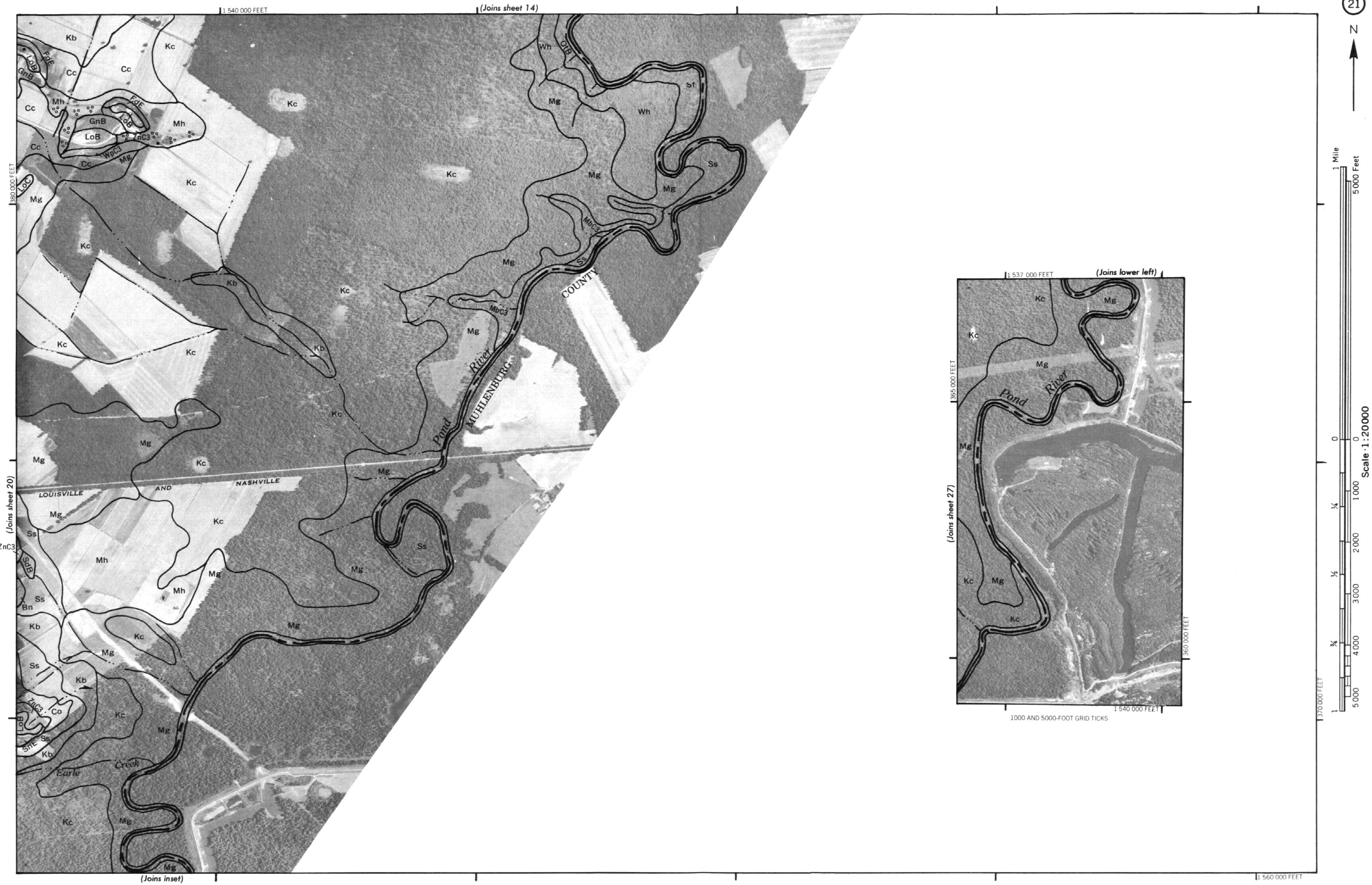
Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

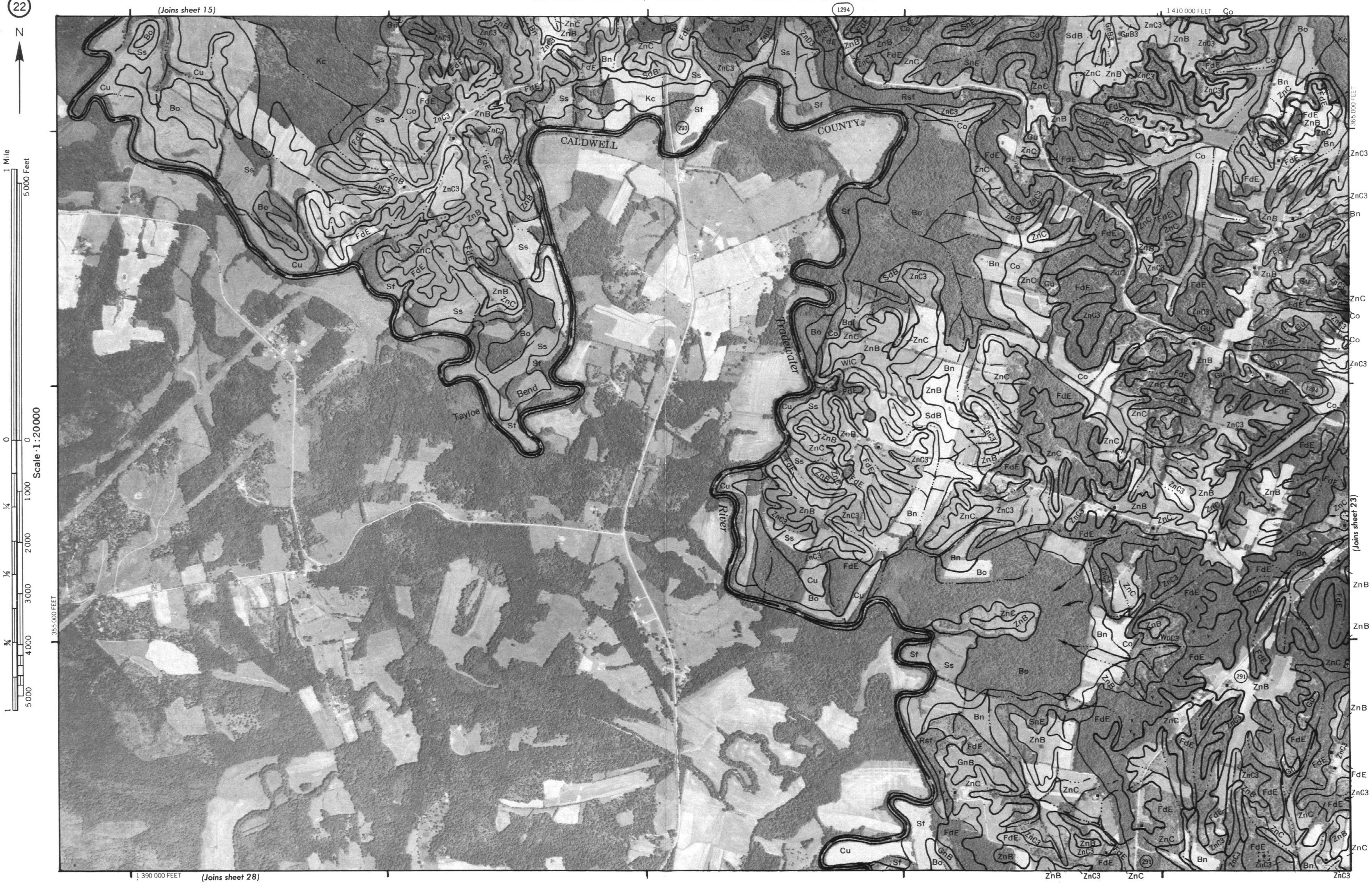
HOPKINS COUNTY, KENTUCKY NO. 20

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 22



HOPKINS COUNTY, KENTUCKY NO. 22

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 23

23

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 23

N

1 Mile
5000 Feet
0
0
1000
2000
3000
4000
5000
¼
½
¾
1

Scale 1:20000

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 24

N

(Joins sheet 17)

(Joins sheet 30)

Scale 1:20000

1 Mile

5000 Feet

0 1/4 1/2 3/4 1

0 1000 2000 3000 4000 5000

HOPKINS COUNTY, KENTUCKY NO. 24

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HOPKINS COUNTY, KENTUCKY NO. 25

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 26

N

(Joins sheet 19)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 32)

Scale 1:20000

1 Mile

5000 Feet

HOPKINS COUNTY, KENTUCKY NO. 26

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

27

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

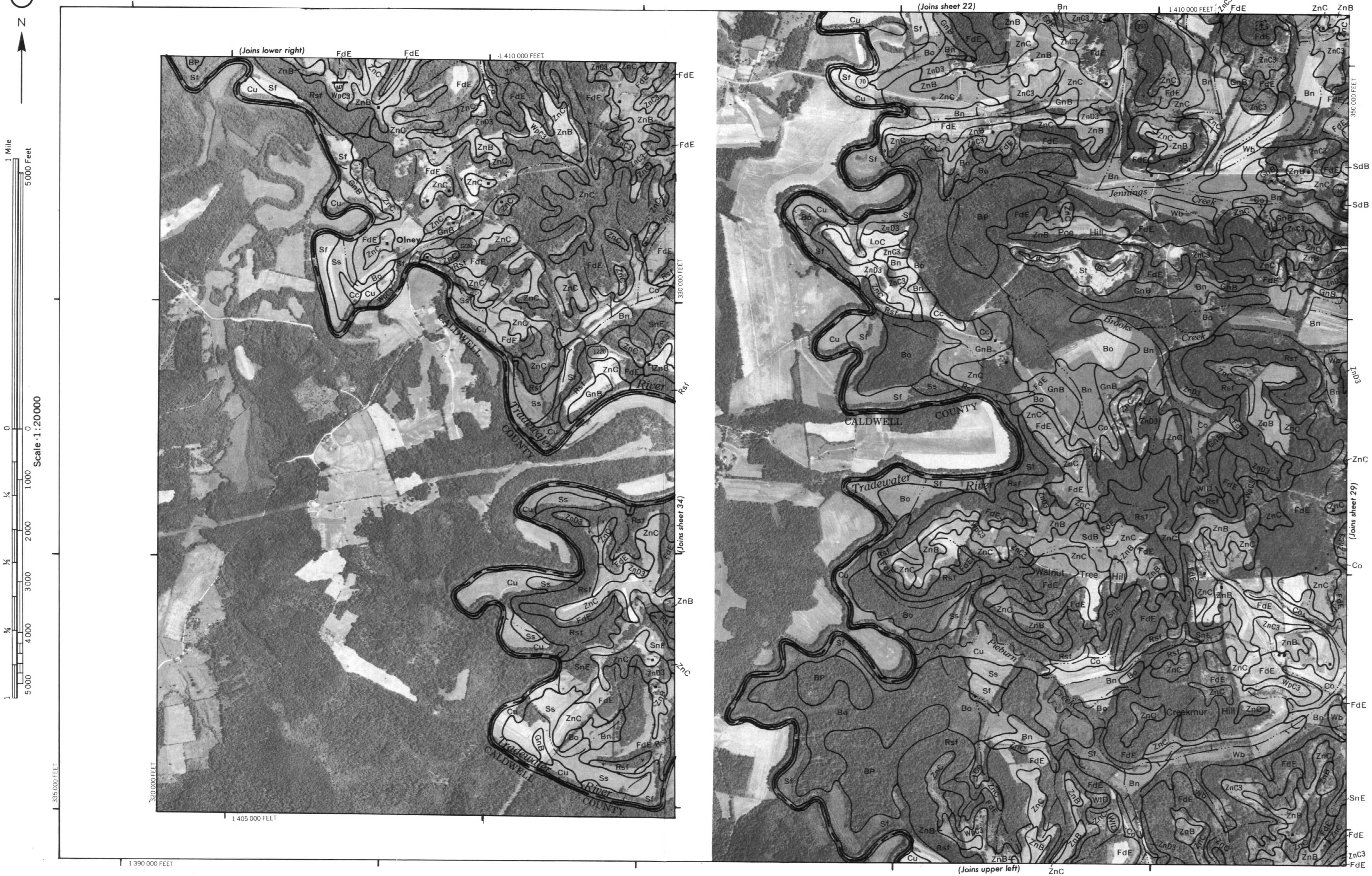
HOPKINS COUNTY, KENTUCKY NO. 27

N

1 Mile
5000 Feet
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

Scale 1:20000

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 28



HOPKINS COUNTY, KENTUCKY NO. 28

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 29

Scale 1:20000

1 Mile
5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

HOPKINS COUNTY, KENTUCKY NO. 30

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 31

HOPKINS COUNTY, KENTUCKY NO. 32

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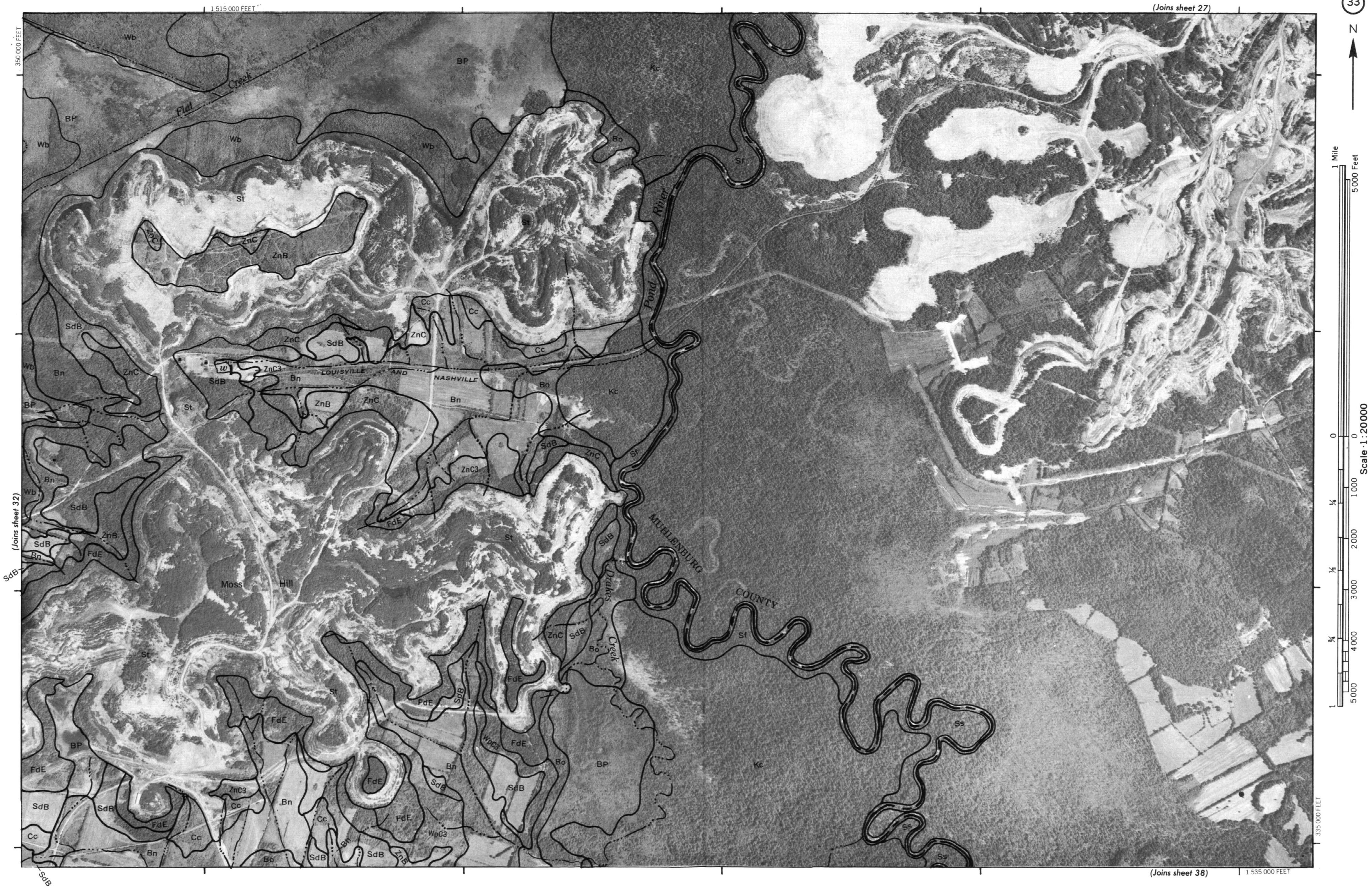
HOPKINS COUNTY, KENTUCKY NO. 33



HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 34

HOPKINS COUNTY, KENTUCKY NO. 34

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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HOPKINS COUNTY, KENTUCKY NO. 35

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 36

HOPKINS COUNTY, KENTUCKY NO. 36

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

37

N

1 490 000 FEET

(Joins sheet 32)

330 000 FEET

(Joins sheet 36)

(Joins sheet 38)

320 000 FEET

(Joins sheet 42)

1 510 000 FEET

1 Mile

5000 Feet

Scale 1:20000

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

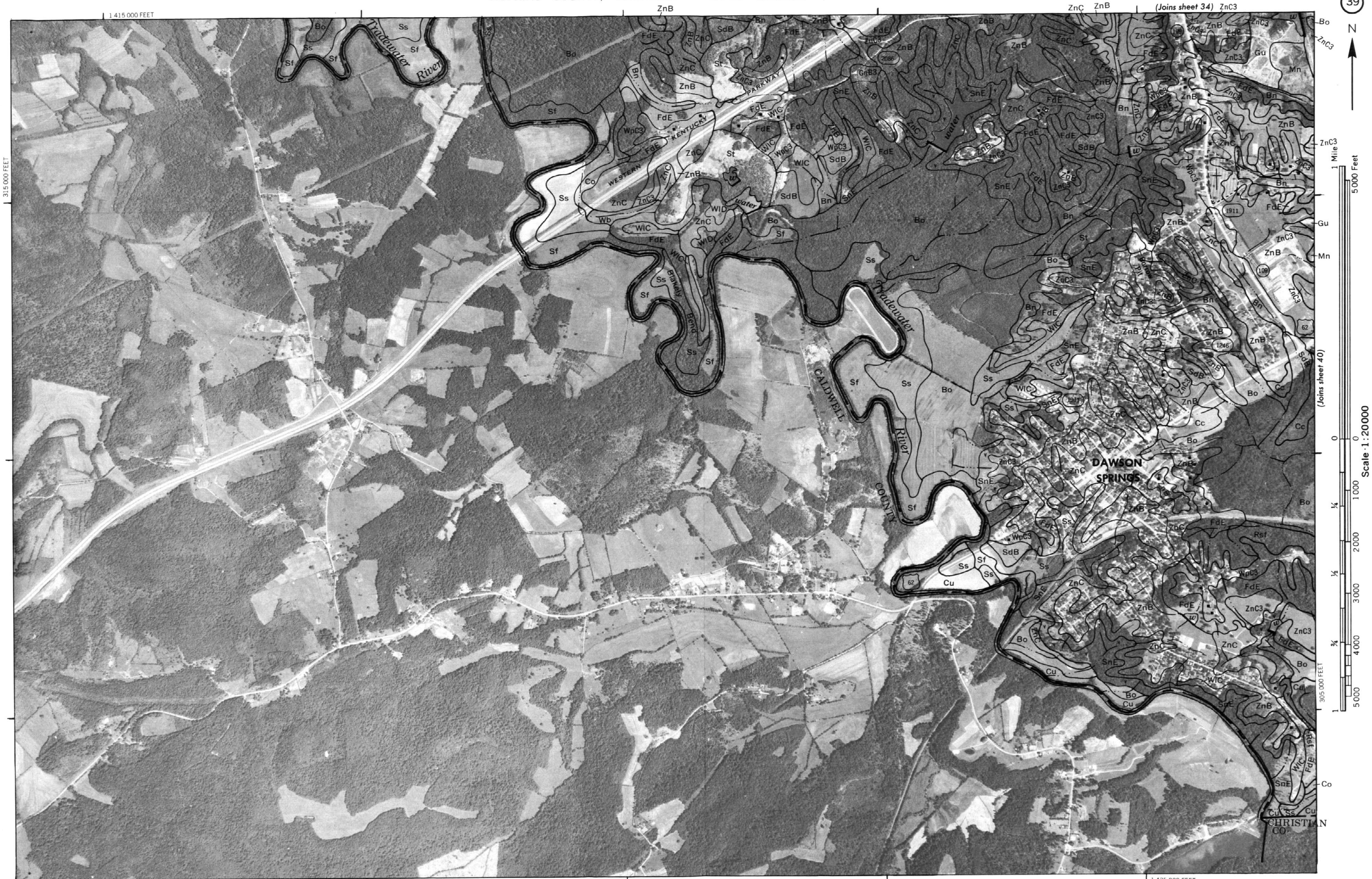
HOPKINS COUNTY, KENTUCKY NO. 37

38

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 38

HOPKINS COUNTY, KENTUCKY NO. 38

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 39

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 40

HOPKINS COUNTY, KENTUCKY NO. 40

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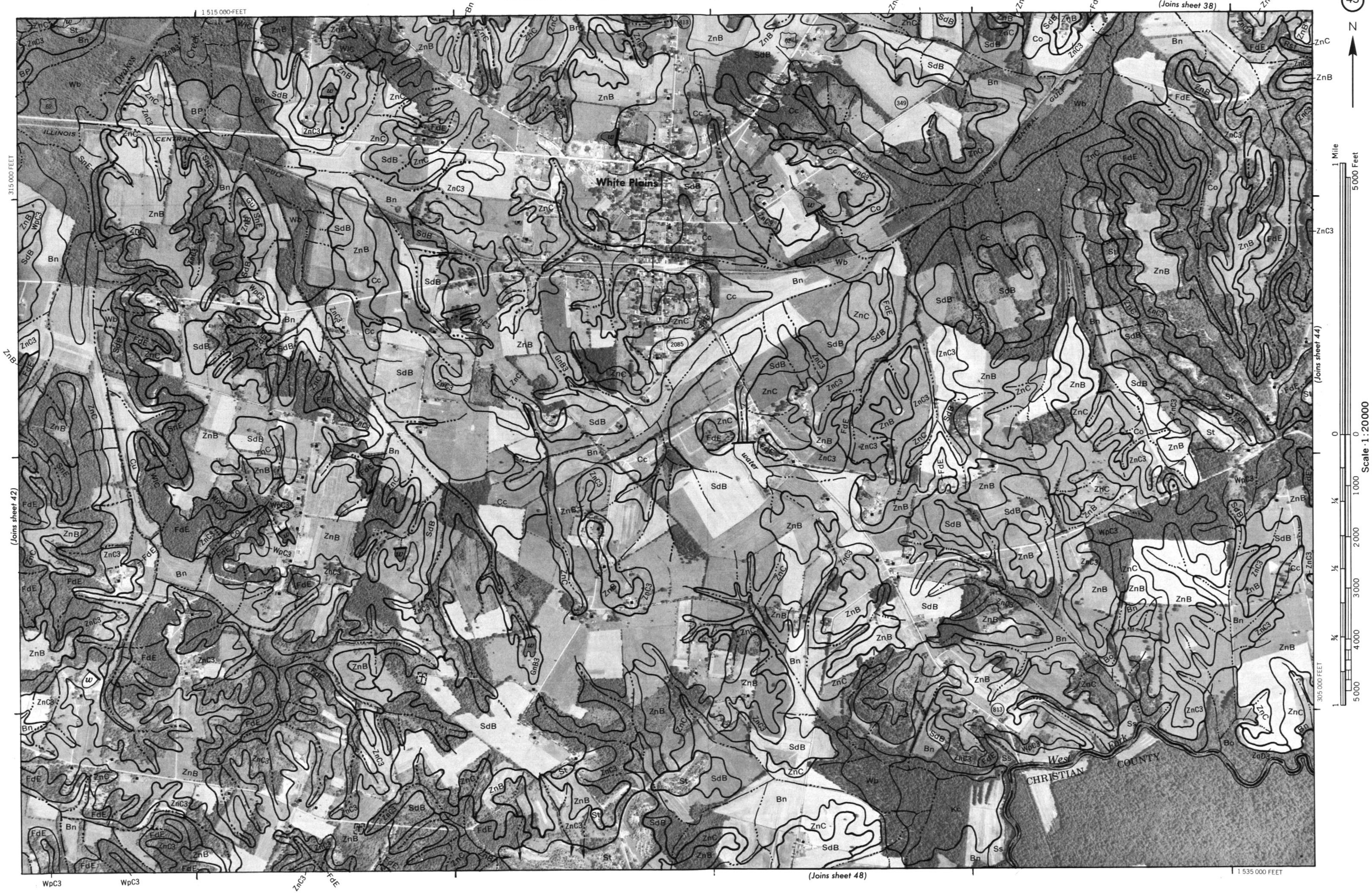
HOPKINS COUNTY, KENTUCKY NO. 41

HOPKINS COUNTY, KENTUCKY NO. 42

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

43



HOPKINS COUNTY, KENTUCKY NO. 43

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 44

1 560 000 FEET

315 000 FEET

HOPKINS COUNTY, KENTUCKY NO. 44

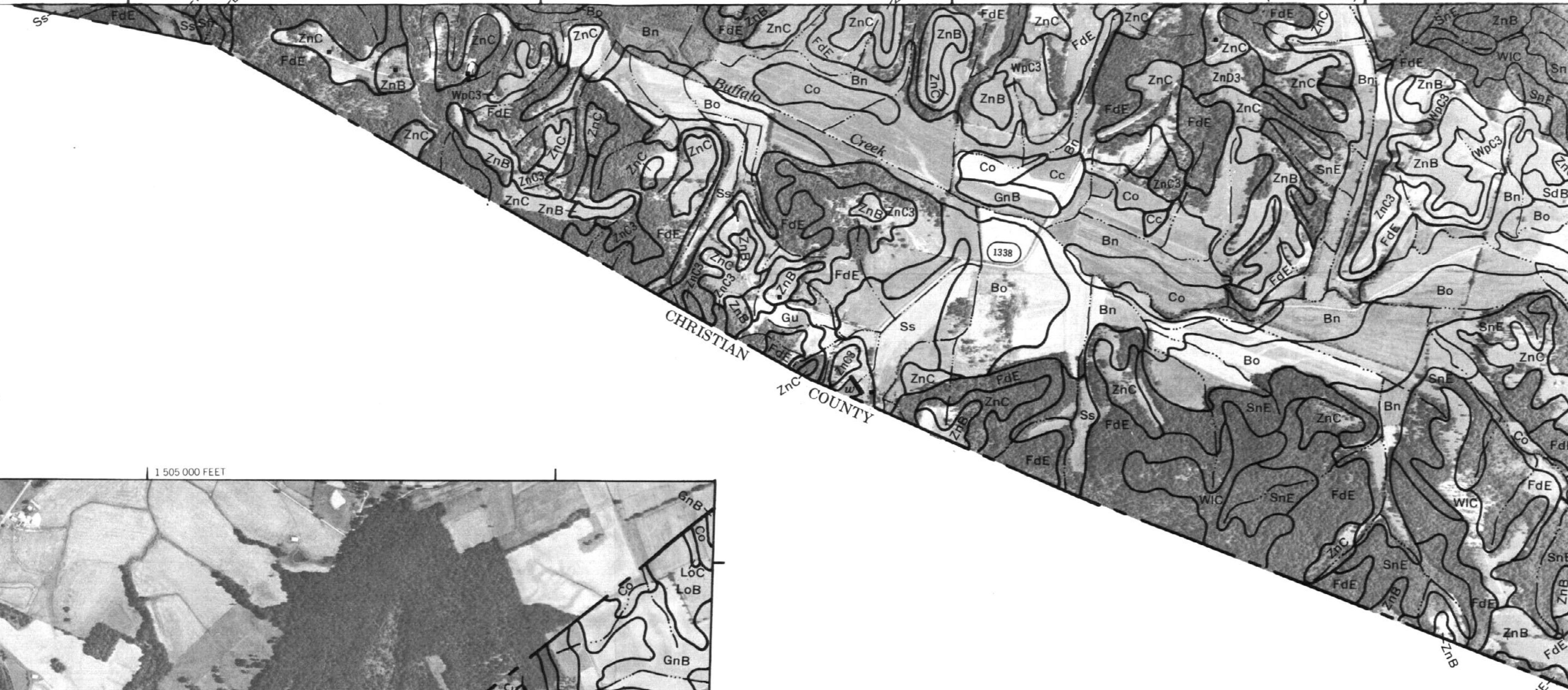
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

45

N

1 440 000 FEET

300 000 FEET



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 45

290 000 FEET

1 460 000 FEET

Scale 1:20000

1 Mile: 0, ¼, ½, ¾, 1

5000 Feet: 0, 1000, 2000, 3000, 4000, 5000

HOPKINS COUNTY, KENTUCKY — SHEET NUMBER 46

HOPKINS COUNTY, KENTUCKY NO. 46

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HOPKINS COUNTY, KENTUCKY NO. 47

N

1 Mile
5000 Feet
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
Scale 1:20000

HOPKINS COUNTY, KENTUCKY NO. 48

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.